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NEW YORK, SATURDAY, APRIL 28, 1906.

Editorial 855
The Earthquake and Fire at San Francisco..... 858
Production of Electrical Apparatus in 1904..... 859
Death of Prof. Pierre Curie..... 859
An Appreciation of Lemuel Bannister..... 859
The Iowa Electrical Association Convention..... 860
The N. E. L. A. Exhibit at Atlantic City..... 861
New York Central and New Haven Locomotives. By Frank J. Sprague 861
The Franklin Bicentenary in Philadelphia..... 862
Current News and Notes..... 862
A New North Italian Hydro-Electric Power Plant..... 865
Massie Wireless Telegraph System..... 867
Atmospheric Electricity and Trees. By Prof. A. G. McAdie..... 870
The Boston Edison Company's Natick Station..... 874
The Diversion of Water from Niagara. By Alton D. Adams..... 875
The Development of the Westinghouse Company's Single-Phase Railway System 876
Speed Control of Hydraulic Turbines..... 877
New Telephone Patents 878
LETTERS TO THE EDITORS:
A. I. E. E. Election..... 879
Motor-Generator Fly-Wheels 879
Digest of Current Electrical Literature..... 880
Book Reviews 883
Sumter "Unitype" Telephone Switchboard..... 884
Adjustable Switch Box..... 884
Electric Power in the Manufacture of Railroad Frogs..... 885
Portable Recording Steam Gauges..... 886
Cable Clamps in Service..... 886
High-Efficiency Incandescent Lamps..... 886
Solid Insulation for Underground Conductors..... 887
Dry Battery Fan..... 887
Industrial and Commercial News..... 888
General News 891
Weekly Record of Electrical Patents..... 899

OUTPUT OF ELECTRICAL APPARATUS.

We print in this issue the preliminary report of the Bureau of the Census on the production of electrical apparatus and machinery for the calendar year 1904. It gives a total value of $157,949,514 as compared with $104,746,319 in 1900, a gain of 50 per cent in the short period. Our own estimate made at the beginning of 1905 was $175,000,000 for the total inclusive output, a figure that is thus shown to be very close to the fact, although discrepant as to some of the constituent items. There are several concerns in this country outside the electrical field that make their own apparatus, which of course is not included, and a great many of the public service corporations, telegraphic, telephonic, electric lighting and electric railways make considerable apparatus and in the aggregate do an enormous amount of what is grouped as "custom work and repairing." None of this is included in the $157,000,000. Bare copper and iron wire, poles, etc., are not in this showing, but an attempt was made to include cross arms, cord adjusters, rail bonds and miscellaneous items that are in reality distinctively electrical. Porcelain electrical supplies and pottery and fire clay conduits are not reported, but appear in the pottery manufacture group.

One notable feature is the small gain in dynamos and motors. A leading reason is that the transition has been from the small units of old to the large three-phase generators, so that with a great increase in capacity the price has fallen enormously per horse-power; and the same statement applies to the average motor since 1900. The gain in incandescent lamps for the period was the largest of all, but here the reverse fact probably applies in an appreciation of price as well as the increase in quantity, as it is known that 1905 was almost stationary as to incandescent lamp production. The detailed figures are now awaited as to the entire production with great interest.

THE SAN FRANCISCO DISASTER.

The news of the terrible earthquake and fire at San Francisco has fallen with stunning effect upon the nation; but the recovery has been swift and the outflow of charity has been magnificent. The fact was always recognized that the city was liable to shock, but as a matter of fact, with its prevalent wooden construction it was, as shown, much more vulnerable to fire. The damage has been very serious, but like the loss of life, tremendously exaggerated in the natural alarm and confusion attendant upon the deprivation of more than 250,000 people of their offices, stores and homes. The work of restoration and renovation has already begun and will be pushed apace until a more stable, beautiful and more prosperous city occupies approximately the site of the old one. California and San Francisco will be no less desirable places of residence and business than they have been since the days of '49; and the exhibition of courage and confidence there is most stimulating as to the future. Meantime, it is obvious that the demand for new constructive material will be tremendous, and a large part of it must be for electrical supplies and apparatus of all kinds—wire, motors, lamps, telephones and all the indispensable adjuncts of modern civilization that depend upon current. Incidentally we cannot withhold hearty praise from the

brave telegraph operators who stuck to their posts through indescribable horrors and dangers, and thus kept the stricken city in touch with the rest of the world.

The Iowa Convention.

The convention last week of the Iowa Electrical Association was up to the high standard set by that association in its meetings of the past several years. In practical value to central station men operating in small and medium-sized towns, the proceedings of this wide-awake body are of unique value, and should serve as a model to similar associations. We are glad to note that a discussion on the grounding of secondary low-tension circuits formed an important part of the proceedings. We have repeatedly urged the importance of grounding the secondary as a safety precaution, and it is not unlikely that this will be made compulsory everywhere within a few years. Nevertheless, there are yet many of the smaller stations which have failed to avail themselves of this very cheap form of liability insurance, and to these we particularly commend the above-mentioned discussion. All those taking part were strongly in favor of grounding and in most of cases their opinions were supported by practical experience—a costly one in at least one instance. The discussion on the results of experience in the practical operation of steam turbines is of particular interest from the fact that it dealt with details which heretofore have not been brought forward. The turbine efficiency test communicated is also of special interest from the fact that the test was conducted entirely by the operating company, and the results are, we believe, the first published in this country coming from an entirely disinterested source.

The paper of Prof. Shepardson on technical men in central station work brought out forcibly the fact that central station companies are far behind manufacturing companies in appreciating the value of technical graduates. It is certainly a reflection on the central station industry that so small a percentage of technical graduates in recent years have gone into central station operation. When we note the practice of successful central station operating syndicates in seeking technical graduates, the conclusion is inevitable that the companies which have ignored this means for the advancement of their interests are not awake to their opportunities. The situation may be stated briefly as follows: In taking on the staff of a central station raw material, which is preferable—the young man taken from the ordinary walks of life, or the technical graduate with a mind well trained by years of systematic study, with well-grounded knowledge of every technical principle applying in central station work, and eager to a fault to be up to date in everything pertaining to his work? Experience in manufacturing lines has demonstrated the great flexibility of the technical graduate, but a small percentage of whom remain in purely technical positions, the great majority finally being absorbed into the administrative and commercial departments, where their technical knowledge serves as an admirable check in almost every matter coming up for action.

The subject of depreciation of central station properties has apparently always been such a painful one for the central station man to discuss, that it is seldom brought up in electric light conventions except in connection with the marvelous accounting methods of some municipal plants. The electric lighting industry is now settling down to a stable basis and depreciation due to the changes in the art is not so enormous as in the early days. There are those who maintain that the increase in the value of a public service company's business in the ordinary city will take care of depreciation. This has been true in the past in America to a large extent, or many more companies would have been wrecked as a result of reconstructions, but it will be less and less true as years pass by. Depreciation must be taken into account in one way or another, either by money invested from year to year in the business or by a sinking fund set aside each year out of the net earnings. In many cases the profits have been put back into the business by the purchase of new machinery, enlargements and extensions in such a way as virtually to amount to taking care of depreciation. A very limited number of companies in Iowa, as shown by Prof. Bissell's paper, provide for a sinking fund. With the short-term franchises now becoming common and the insistence of capitalists upon better security, depreciation must be given vastly more attention than the subject has received in the past.

Color Photometry.

The paper by Herr Satori, abstracted in our Digest this week, will amply repay thorough reading. It sets forth with commendable clearness the situation with respect to color photometry, which is at once the most difficult and the most interesting branch of the subject—the most difficult because it leads us at once into physiological complications of a very troublesome character—the most interesting because it involves problems of vital importance to future improvements in illumination. Color photometry dates back even to Fraunhofer, like so many other fundamental researches in optics, but neither he nor any of his successors evolved any simple and satisfactory method of dealing with the problem. If the luminosity of the solar or any other spectrum could be measured in terms of fixed quantities the task would be an easier one. As it is, however, the physiological variable of the eye render color photometry a work much like trying to lay off a base line with a rubber band as the standard of length. Of course, Purlinje's phenomenon, with the uncertainty it introduces, has been painfully well known to all investigators in this domain, but in view of the "Duplicity Theory" of vision, which is the result of recent researches, it takes on a new and startling significance. Briefly stated this theory ascribes to the "rods" and "cones," which, packed closely on end, make up the velvet-like structure of the retina, quasi-independent functions. The former are not color sensitive and play the most important part in vision in very weak light. The latter are strongly color sensitive and the sensation derived from them is predominant in ordinary seeing.

The most striking fact that all eyes are color blind in very weak light, and that peripheral vision in the region of few cones is notoriously lacking in color sensitiveness, thus finds a simple reason for being. It is as if in photography one were to overlay a strongly stained and rather slow emulsion with a film highly sensitive, but unstained and rather poor in silver. In weak light the resulting negative would owe nearly its whole density to the latter layer and would show no orthochromatic values, while on a full exposure it would be strongly orthochromatic with density mainly due to the lower emulsion. In the eye the sensitive layers are, of course, in the same plane, but varying in distribution over the retina. Now in photometry one deals simultaneously with rod-vision and with cone-vision in varying and generally unknown relation. In normal vision under illumination of useful intensity for ordinary purposes the cones have the better of it

and color vision is the important consideration. In weaker and weaker light the cones lose their grip so to speak and only the rods are left in action at last. Hence in color photometry the results under weak light when rod-vision predominates do not correctly represent the situation under the conditions of actual illumination. This is bad for all extinction methods as well as for all balancing methods when weak light is used. In either case colored components of the light are likely to fail of getting full justice.

The long and short of it is that photometry and in particular color photometry is in anything but a satisfactory state. To begin with, there is no generally accepted standard of light, and the nearest approximation to it, the Hefner, introduces the difficulties of color photometry to an exasperating degree. Even were there a first-class standard the ordinary processes of photometry involve these purely subjective difficulties in a way that is very often disastrous to precision. It is not the photometer settings that are troublesome, but their interpretation to meet practical conditions. It is not difficult in photometry to obain consistent results, which may, however, be in spite of consistency very wide of the real facts. Perhaps as Herr Satori suggests, photographic methods may make up in reliability what they lack in directness, but we hardly think they have yet been sufficiently developed to be generally used to advantage. The whole subject is just now worth especial investigation on account of the introduction of illuminants giving strongly selective radiation, and for this very reason capable of very high efficiency. So long as one dealt with illuminants of approximately uniform color quantity, comparisons, irrespective of color, were measurably fair. To-day, however, with Welsbachs and enclosed arcs, mercury tubes and flaming arcs all in the field in competition, the situation is greatly complicated. Photometric processes once entirely satisfactory must now be examined very critically and the whole subject needs a thorough overhauling. Even the question of standards of light is further than ever from a solution. The more one deals with the processes of commercial photometry, the more one is dissatisfied with their precision. If one were to take a couple of incandescent lamps and send them around to various institutions to be standardized, we fancy the results would be anything but reassuring. Probably no commercial measurement is subject to greater uncertainty from a greater number of causes.

The Electrical Conductivity of Metallic Oxides.

There is reason for believing that electricity is conducted in three different ways. All of these ways involve the transport of matter. The first way is the bodily movement of a charged body, such as a thunder cloud, or an electrified pith ball. This is a movement of gross matter, usually capable of being observed by the eye. The second way is the bodily movement of electrified atoms, or groups of atoms. This is the electrolytic way. If we take copper electrodes immersed in an aqueous solution of copper sulphate, we suppose that there are plenty of dissociated molecules, i. e., atomic constituents, swimming about loose in the solution The supposed free constituents are copper atoms and sulphion groups. For some reason, when a neutral copper sulphate molecule splits up in water into constituent copper atom and sulphion group, the copper travels about with a positive charge and the sulphion groups with a negative charge. These swim about like electrified pith balls. A potential difference applied to the electrodes establishes an electric gradient, or field of force in the solution, and the electrified pith ball constituents immediately begin to travel in opposite directions towards the positive and negative electrode, respectively. When they arrive at the goal, they give up their electric charge and are thereby rendered incapable of swimming about in solution. They pile up on the electrode in material form as a solid, liquid or gas. The conductivity of the solution depends upon how many dissociated molecules there are in it, and also on the speed at which they can travel under a given electric intensity of field—that is, how little jostling there is. As the temperature of the solution is raised, there will be less jostling, more freedom to move, more velocity and greater conductivity, even if no more dissociation of neutral molecules should occur. In electrolytic conduction the conductivity increases with the temperature.

The third way is supposed to be the bodily movement of particles of matter much smaller than atoms, viz.: corpuscles. These corpuscles are the bricks of which atoms are built, and all bricks are exactly alike, although the atomic structures composed of them differ as much as do brick houses. All individual corpuscles are inherently negatively electrified somehow. Yet normal atoms comprising hundreds or thousands of corpuscles are neutral, and if a corpuscle is abstracted from a neutral atom, the latter remains positively charged. In corpuscular conduction the atoms do not move, but the corpuscles move through them and carry the electric charges up grade, or from the negative toward the positive pole. The movement of the charge is supposed, therefore, to be subatomic. It is further supposed that normal atoms are constantly shaking off corpuscles and taking them on again, in the jostling which occurs when atoms and molecules rub elbows in a solid body; so that a metal has at any instant a plentiful stock of free corpuscles capable of moving at a definite mean speed under an electric field and, therefore, of carrying an electric current. The subatomic, or corpuscular, conductivity of metals tends to increase inversely as the absolute temperature; or to diminish as the temperature increases.

It is commonly supposed that conductivity in a substance is atomic or subatomic—that is, electrolytic or metallic, according as it increases or diminishes with temperature; but this is not a safe conclusion. A paper in the *Philosophical Magazine* for April, 1906, on "The Electrical Conductivity of Metallic Oxides," by Dr. F. Horton, describes experiments on the changes of conductivity of metallic oxides with temperature, going to show that their conductivity is metallic and not electrolytic, although their conductivity increases with enormous rapidity as the temperature is increased. In the case of cupric oxide there appeared to be no polarization of the electrodes and no electrolytic conductivity, although the conductivity increased thirty million times between the limits of 12° C. and 1,038 ° C. On the other hand, investigators have shown that such oxides emit and, therefore, probably contain, more and more free corpuscles as their temperatures is increased, and the observed rate of increase of conductivity agrees with the stated rate of increase in emission of corpuscles. Some of the oxides tested, such as lime, gave evidences of some slight electrolytic conductivity at high temperatures; but the main character of the conductivity appeared to be metallic or corpuscular. If these theories are correct a process for the treatment of copper or iron, whereby the atomic dissociation could be enhanced without destroying the structural properties, would be of enormous value.

The Earthquake and Fire at San Francisco.

Shortly after 5 a.m. on Wednesday, April 18, San Francisco was visited by an earthquake shock of unusual duration and of extreme severity, which made itself felt destructively also in other parts of California. The shocks were repeated during the day, and at intervals during the ensuing week. Great damage and loss of life occurred as a result in various places, but in San Francisco the disaster was rendered horrible and complete by the instantaneous breaking out of innumerable fires in the wrecked buildings. The conflagration swept away the entire business district of the city except parts of the water front, destroying Chinatown, invading Nob Hill and other residential districts, and not stopping until over 250,000 people found themselves homeless and destitute.

At this moment order is slowly working out of chaos in the ruined city, and San Franciscans are bending their energies to the renovation of their homes and offices, aided by the charity of their fellow countrymen already amounting to over $15,000,000. It will be many long months, however, before the ordinary course of events can be resumed, and social and business life can settle down to the normal condition.

The immediate effect of the earthquake and fire was to interrupt all the electric utilities carried on by the public service corporations in the vicinity. Gas pipes, electric light and power wires, railway circuits, telegraph and telephone systems were instantly interrupted and remained out of commission for several days. Up to the time of our going to press little definite information has been secured with regard to specific damage.

The Western Union and Postal Telegraph Companies both lost their headquarters at San Francisco and were driven across the San Francisco Bay to Oakland, although it was not long before they re-established themselves in the stricken city or secured footholds also at such points as Goat Island in the bay, where the cables could be tapped. Throughout the following week thousands of messages have piled up in the hands of both companies, there being no means of delivering them to the addresses in San Francisco or Oakland, as there are no messengers to deliver the telegrams, and in almost every case it would have been impossible to find the persons for whom they were intended. During the first few days very few personal messages could be got through from San Francisco or Oakland, and the wires were occupied chiefly by Government dispatches or by the bulletins describing the disaster furnished by the Associated Press, whose whole force, from Mr. Melville E. Stone down, has been working night and day keeping the newspapers supplied with the latest news from the scene of devastation. All the officials of the great telegraph systems have been under tremendous strain since the occurrence, and are now able to announce rapid resumption of the service. The Postal Telegraph Company swiftly installed a dynamo plant and telegraphic apparatus at Oakland, and has been making that city its headquarters for the vicinity, while Mr. J. C. Barclay, assistant general manager of the Western Union Company, states that by Tuesday of the following week the company had opened up offices in San Francisco itself, and had several wires running into the city. The relief train sent by the Western Union to San Francisco had 150 men aboard, including operators, linemen and superintendents; and, as few houses were available for occupancy, provision had been made for housing the staff on tourist cars.

The telephone system on the Pacific Coast was one of the most highly developed in the world and the use of the telephone in San Francisco was unusually extensive. President Fish, of the American Telephone & Telegraph Company, under date of April 23, writes us: "It will be some time before we can expect any definite information as to the condition of the telephone plant in San Francisco. At the present moment I believe that at least two of our exchange buildings escaped the fire and that while they are somewhat shattered by the earthquake they can be restored to service within a reasonable time. I am also informed that the Western Electric Company's building is not destroyed. The new switchboard in the central office is in any event not entirely destroyed. At last advices there had been no opportunity to go into details as to any of the buildings that were subjected to the fire." The new switchboard referred to by President Fish is the largest in the world, and it was understood would have been ready for very early use. The telephone officials on the coast are doing their best to assure a swift resumption of service, realizing its immense value at this juncture.

As is well known, San Francisco has a very extensive street railway system, and a large service for electric light and power. Both were, of course, immediately interrupted, and so far as known have remained out of business up to the present time, while it has been impossible to secure any very definite data as to the amount of damage done. The street car tracks were dislocated in every direction by the earthquake, and many of them have since been encumbered by the ruins of the shock and fire. This is equally true of the electric light and power circuits. As regards the power plants of the United Railway & Investment Company, it appears that the electric power houses are safe, although the company appears to have lost its cable power house, operating the Market Street line, upon which it was proposed shortly to substitute electricity. This cable power house, which was shortly to be abandoned, was insured for $325,000. So far as can be learned, the plants of the Pacific Gas & Electric Company, and the California Gas & Electric Corporation, are practically intact. San Francisco is the center of some of the longest hydro-electric power transmission systems in the world—230 miles—but also generates on the spot large quantities of current in the usual way.

The General Electric Company appears to have suffered very materially from the fire following the earthquake. The only definite information received, however, by the officers came in a telegram from Dr. Addison, manager of the Pacific Coast territory, stating that so far as he knew all the members of the San Francisco organization were personally safe, but everything else had gone. Similar stories could be told with regard to many of the large concerns in the electrical field, but the advices are still meagre. John A. Roebling's Sons Co., which has always carried a very large stock out on the coast, is understood to have lost it all, to the tune of several hundred thousand dollars, while the Allis-Chalmers Company also reports the loss of its offices and of $20,000 at least in material. The insurance in all cases, whether of public service corporations or of commercial organizations, appears to be ample, while up to the present time no single case of loss of life has become known of anyone connected with the electrical industries.

For a time submarine cable communication with San Francisco was interrupted and advices eagerly sought for by residents on the Sandwich Islands, Australia, etc., were secured by sending messages the other way around the world. The Commercial Cable Company is now able to report, however, that its underground lines in San Francisco are uninjured and that business has been resumed.

It is impossible at this moment of writing to state what will be the nature of the plans of the local public service companies in the near future, and this uncertainty may continue for some time, although all the companies are, as indicated above, making vigorous efforts to get in complete running order again. One of the largest of the new projects at San Francisco was that of the San Francisco Coke & Gas Company, which had worked out plans for a large electric light plant to be located near the present gas works at North Beach, the idea being that it would thus be possible to obtain gas cheaply for gas engines driving the generators. This plant was to have been equipped also with underground conduits and was intended to supply some of the most profitable districts of the city. The plant, which would cost $1,500,000, was intended to be sufficient to carry on the business until the transmission system of the Stanislaus Electric Power Company, now in course of construction in the mountains, could reach the Golden Gate. Several sites were under consideration for the new electric light plant and for the new gas works, but what will now be done under the radically changed circumstances is not known.

A hearty word of praise is due to the telegraph operators who, under conditions of danger and exhaustion, remained at their posts, and even returned to their keys at the peril of death. The

first news of the earthquake came from a Postal Telegraph operator, who reported the disaster while the walls and ceilings were falling around him, and then with the humorous remark: "Me for the simple life!" managed to make a hairbreadth escape.

The latest dispatches now available from the scene are those of April 24. They state that 80 men from the Benicia Signal Corps, referring doubtless to the United States Signal Corps, had arrived and were at work on the Government telegraph and telephone lines. The Home Telephone Company announced its intention to begin work at once on a new independent system to cost $4,000,000 in the next three years. With the resumption of telegraphic communication, the Stock Exchange has opened again. "Within twenty-four hours probably four street car lines will be in operation in the city, and the streets of two extensive districts will be lighted by electricity. The United Railways assert that their lines are safe for operation, and the cars will be run perhaps to-day. The lights will be turned on as soon as the wires leading into the houses which might prove a source of danger have been cut. This work is progressing rapidly." Mr. G. H. Davis, chief engineer of the United Railways in San Francisco, reported the loss on the property at $2,000,000. The securities of the company have meantime shown a decline of $16,250,000. Moreover, a large part of the loss is insured. All the electric cars—455—were saved, except 7, and only 75 out of the 423 cable cars were lost. The street railway company through its engineers, Ford, Bacon & Davis, of New York City, is already making plans to meet the new conditions of route that will arise with the rebuilding of the city.

Production of Electrical Apparatus in 1904.

The Director of the Census announced this week the result of the tabulation of the statistics of Electrical Machinery and Apparatus for the calendar year 1904, forming a part of the Census of Manufactures of 1905, taken in conformity with the Act of Congress of March 6, 1902. The figures indicate that there has been a substantial increase in this industry in the United States, as compared with the statistics of 1900, which covered the fiscal year ending May 31st. Comparative figures for 1905 and 1900 are shown in the following summary:

	1905.	1900.	Per cent. of increase.
Number of establishments...	783	580	35.0
Capital	$191,469,874	$83,130,943	130.3
Salaried officials, clerks, etc.:			
Number	11,590	4,987	132.4
Salaries	$11,675,576	$4,563,112	155.9
Wage-earners:			
Average number	59,336	40,890	45.1
Wages	$31,226,721	$20,190,344	54.7
Miscellaneous expenses	$17,934,878	$6,788,314	164.2
Total cost of materials used	$66,728,176	$48,916,440	36.4
Total value of products..(1)	$140,614,481	$91,348,889	53.9

(1) Exclusive of $17,335,033 reported as by-products of other industries, the aggregate value of electrical machinery and apparatus production for 1905 being $157,949,514.

The principal products are summarized as follows:

Dynamos	$11,084,234	$10,472,576	5.8
Motors	22,370,626	19,505,504	14.7
Carbons	2,710,935	1,731,248	56.6
Incandescent lamps	8,319,159	4,036,112	106.1
Telephone & teleg. apparatus	16,974,892	12,154,678	39.7
Insulated wires and cables..	34,519,699	21,292,001	62.1
All other products.....	59,171,047	33,490,464	76.7
Custom work and repairing	2,798,922	2,063,736	35.6
	$157,949,514	$104,746,319	50.8

The figures are "factory" values, and do not include therefore the profit make in marketing or the actual amount paid by the public. They do not include such details as insulators, poles, etc., which are part of the pottery and lumber statistics, although these appliances are made and employed solely for electrical purposes. Moreover they do not embrace the large amount of manufacturing and repair work done by the thousands of public service corporations throughout the country. In addition to the 783 electrical manufacturing plants, there are a number of industrial concerns that make electrical apparatus for themselves but not for sale. It is believed that these additions would bring up the total to the estimate given by the Electrical World for 1904 of about $175,000,000 electrical product.

Death of Prof. Pierre Curie.

A cable dispatch from Paris, dated April 19, states that Prof. Pierre Curie, who, with his wife, discovered radium, was run over and killed by a vehicle in Place Dauphine, in the Latin Quarter. Pierre Curie was born in Paris on May 15, 1859, and received his university education at the Sorbonne. In the year 1879, at the age of 20, he undertook a series of chemical researches on his own account. It was while engaged upon this work that he met Mlle. Marie Sklodowska, who had come from Poland to Paris to study mathematics, physics and chemistry. In 1895 Mlle. Sklodowska became the wife of Curie, who was then professor in the Ecole de Physique et Chimie, of Paris. Mme. Curie was appointed a professor of physics at the High School of Sevres, from which she received the degree of Doctor of Science for her work with radium. Her researches in science have been interlinked with those of her husband, and their names have been inseparably associated in their later work. The work of the Curies was carried on in a small laboratory in the Rue L'Homond, the expenses of the undertaking being obtained from their limited private resources. During a series of experiments on the conductivity of air under the influence of the rays of uranium and thorium, known as Becquerel rays, they made a searching investigation of the properties exhibited by compounds of the two metals, and were led thereby to the discovery of radium.

The first results of their work were communicated to the Academy of Sciences in 1898. In the year 1901 the Academy of Sciences awarded to them a prize of $2,000. The Nobel prize of $40,000 for scientific discovery was also presented to them, which they set aside for carrying on their researches. In 1903 they received the Davy medal, awarded by the Royal Society of Great Britain, for the greatest chemical discovery of the year. Prof. Curie refused the decoration of the Legion of Honor. When offered, he was reported to have said: "I am of the opinion that the hope of receiving decorations is not necessary as an inducement to acts of devotion or courage." Prof. Curie leaves one child, a daughter nine years old.

An Appreciation of Lemuel Bannister.

With reference to our recent obituary notice of the late Mr. Lemuel Bannister, we have received the subjoined appreciation from Mr. L. B. Stillwell, the consulting engineer, who was like some others who have since risen to eminence a protégé of Mr. Bannister and associated with him in the early upbuilding of the Westinghouse electrical manufacturing interests in Pittsburg:

"Few men making no pretence of technical knowledge have contributed more to the remarkable increase in the use of electricity during the last fifteen years than the late Lemuel Bannister. Chosen to be first vice-president of the Westinghouse Electric and Manufacturing Company at a time when that company was laboring under great financial difficulties, the confidence inspired by his integrity of character, his profound knowledge of sound business principles and his exceptional ability in meeting and solving commercial problems were most effective factors in placing his company upon a sound financial basis.

"Entering the electric field at the age of fifty his mature experience and conservative temperament were of great value in the commercial development of the industry and were influentially felt far beyond the limits of the company with which he was connected. This valuable influence has been recognized freely not only by those who have had the good fortune to be closely associated with him but by his ablest business competitors in other companies. Particularly did his character and ideas impress themselves upon the technical staff and commercial representatives of his company, and the writer has never talked with a man who was a member of either of these organizations during the years of Mr. Bannister's active administration who does not acknowledge with appreciation and high personal regard the benefit derived from this early association.

"As regards the effect of his work in establishing the confi-

dence of purchasers of electrical machinery in the ability of the designer and the builder and in the sincerity of the seller, probably no man in America or Europe has surpassed him. To the remarkable development and extension of the uses of electricity in every-day life, which in the industrial field is the most striking factor in the world's progress during the last twenty years, many have contributed. On the side of production, the inventor, the designer, the builder, the engineer, the lawyer, the seller, the organizer and the business executive, each is entitled to his share of credit. On the side of use the buyer and his engineer and builder and lawyer also have had their work to do, and in the important work of establishing and maintaining between producers and users relations profitable to both, recognizing the rights of both, and therefore, essentially satisfactory to both, no man has contributed more than Lemuel Bannister."

The Iowa Electrical Association Convention.

The Iowa Electrical Association held its sixth annual convention at Des Moines, Iowa, April 18 and 19, 1906, at the Kirkwood Hotel. At the first session held Wednesday morning, President Burt, of Waterloo, introduced Mr. Milo Ward, secretary of the Commercial Association of Des Moines, who gave the address of welcome.

President Burt, in a brief address, called attention to the increasing importance of the work of the Iowa Electrical Association to Iowa central stations. In these days of large syndicates which are constantly "gobbling up" new properties, it is pertinent to ask: Are you prepared to be "gobbled"? Do you have your business in such shape that you know exactly where you stand financially? Are you keeping records which make it possible to determine how much your properties are really worth, and how they compare with other properties in the same State? Are you prepared to meet the present much-talked-of movement to regulate rates of all kinds by facts and figures showing whether the present rates are reasonable? In all these things the association is a help.

Secretary George S. Carson's report dealt mainly with an investigation he had carried on during the past year to determine the financial condition of Iowa central station companies. Out of 130 operating companies he had received reports from 82, of which 5 had to be rejected because of the combination of central station with other business. From the 77 companies remaining the following figures were obtained:

Capital stock	$3,679,525
Bond issue	2,495,100
Total bond interest	130,290
Total paid out in dividends	108,837

8 were earning dividends of 10 per cent.
15 were earning dividends of 8 per cent.
10 were earning dividends of 7 per cent.
10 were earning dividends of 6 per cent.
5 were earning dividends of 5 per cent.
2 were earning dividends of 4 per cent.
2 were earning dividends of 3 per cent.
2 were earning dividends of 2 per cent.
25 were earning no dividends.

The average dividend was 2.95 per cent. The population served was 401,398, so that the total issue of securities was less than $15 per capita, which is very much less than in the State of New York, with which he had made some financial comparisons. He urged the members to make more effort to learn what other plants are doing in the way of economy and development of business.

The report of the executive committee announced the appointment of Mr. George S. Carson, of Iowa City, as secretary during the year to fill the resignation of P. E. Bellamy, of Knoxville. It was voted by the executive committee to hereafter give the secretary a salary of $250 per year.

The publication committee which issued the printed proceedings, reported an income from advertising of $600 and an expense for publishing the proceedings of $241, leaving $359 to be turned into the association treasury. The association passed a special vote of thanks to the publication committee for its remarkable showing.

A nominating committee was elected consisting of W. J. Greene, of Cedar Rapids; L. D. Mathes, of Dubuque; George S. Carson, of Iowa City; Austin Burt, of Waterloo, and D. F. McGee, of Red Oak. This nominating committee reported at the afternoon session the following day in favor of the following officers, who were elected: President, Mr. A. W. Zahm, Mason City; vice-President, Mr. George S. Carson, Iowa City; secretary, Prof. L. B. Spinney, Ames, Iowa; treasurer, Mr. W. A. Mall, Belle Plaine; executive committee, the officers, and Messrs. L. D. Mathes, of Dubuque; O. E. Brownell, of Lake City, and W. N. Kiser, of Des Moines.

Invitations were received from the electric light and railway interests of Clinton and of Des Moines for the next convention. After some discussion it seemed to be the consensus of opinion that while Des Moines' hospitality was appreciated, and while it was the most convenient point in the State, it would be well to follow the precedent established the past few years of meeting every other year in Des Moines and every other year in some of the other towns where there were interesting developments in electric lighting and railway work. The invitation of Clinton was seconded by representatives from Davenport. It was shown that much electric work of interest in Clinton and Davenport would be ready for inspection by the next convention. It was voted to hold the next convention at Clinton.

Mr. George S. Carson, at the close of the convention, presented the association with a Crosby steam engine indicator. It is the intention to make this the beginning of a collection of testing instruments to be kept in the custody of the Iowa State College at Ames. The engineering department of that institution has already become a kind of testing headquarters for the central stations of the State.

PRESIDENT A. W. ZAHM.

During the convention the Des Moines City Railway kept a special car in operation every half hour between the hotel and the power plants of the Des Moines Edison Light Company and the Des Moines City Railway Company. Free transportation was issued by the Des Moines City Railway Company and the Interurban Railway Company to all delegates both to the Iowa Electrical Association and to the Iowa Street & Interurban Railway Association, which met at the same hotel April 19 and 20.

Mr. A. W. Zahm, the new president of the Iowa Electrical Association, has taken a prominent part in the affairs of the association for the past four years and is among its most progressive members. Mr. Zahm is 35 years of age and was born and brought up at St. Paul, Minn. He attended the University of Minnesota, but is not a graduate. He began electrical work with the Northwest Thomson-Houston Company, St. Paul, this company being then under the management of H. M. Byllesby. After three years with this company he became manager of the Manhattan Light, Heat & Power Company of St. Paul, where he remained five years. After this he spent one year rebuilding the electric light plant at St. Cloud, Minn. Upon finishing this work he took the management of the Brice Gas & Electric Company, of Mason City, Iowa, which position he now holds.

Abstracts of the papers presented at the convention and of their discussion will be printed next week.

The N. E. L. A. Exhibit at Atlantic City.

Note has already been made of the fact that the National Electric Light Association has taken Young's Pier for the exhibits at the Atlantic City convention, June 5, 6, 7 and 8. Mr. Arthur Williams, chairman of the convention committee, notifies us that the executive committee has decided to recommend to the exhibitors the adoption of a uniform style of booth construction and decoration. A comprehensive plan has been submitted by Mr. M. A. Singer, who has done a great deal of highly commended work for other associations.

It was understood at the executive meeting that this letter of recommendation should be issued, urging that, as far as practicable Mr. Singer be given the work. He has made prices of $56, $60, $67.50 and $70.50 for complete booths, according to their location. Where exhibitors have more than one section 10 by 10 ft., concession will be made offsetting the saving of labor and material. This will be a matter of negotiation in each instance.

Mr. Singer, or his representative, is to see each exhibitor—the object of this notice being simply to advise the membership of the action of the executive committee and of the desire to have a uniform plan of decoration in keeping with the best exhibition work here and abroad. Mr. Singer's figures include the erection of the booth on a platform five inches in height, with railings, fluted columns, cornices, lettering, electric lighting (there will be ten lamps to each 100 sq. ft.), and all wiring, including the supplying mains from the Atlantic Electric Light & Power Company's services. Neither the Association nor any member of the committee has any interest in Mr. Singer's contracts.

New York Central and New Haven Locomotives.

By Frank J. Sprague.

Commenting, in your issue of October 21, 1905, upon the proposed New Haven locomotives at the New York Central's terminal, I stated that as they were designed to operate at a maximum of about 250 volts alternating per motor at full normal speed, when in the direct-current zone they would of necessity be coupled in series in units of two because of the higher potential, with the result that when operating at switching speeds up to about twelve miles an hour they would require at least twice as much current for like train weights as the Central's locomotives, because the latter's motors were designed for 600 volts.

I hardly need to refer in detail to the comments these statements aroused, but an attempt was made to belittle them by distributing this excess demand over a long run, and ignoring local yard movements, despite the fact that this excess falls entirely upon a single sub-station.

Again, at the last meeting of the Railroad Club I called attention to a comparison of the Central and New Haven locomotives, and especially to the great weight of the latter in proportion to its capacity under like conditions, stating that the former has about 70 tons weight on the drivers, its motors measuted on the hour rating and without special ventilation aggregate 2,200 hp capacity, and it is guaranteed to handle trains of from 400 to 550 tons, according to the schedule; while the New Haven alternating-current locomotive is variously reported to have from 72 to 95 tons on the drivers, to have an hour rating without ventilation of only 1,000 hp, and is intended to handle trains of 200 to 250 tons. Ventilation is, of course, equally possible to both, and hence comparisons should be made under like conditions.

I have waited with reasonable patience for the official curves of performance of the New Haven machines, and those given in the detailed description in your issue of April 14 not only confirm my criticism, but are pregnant with interest. According to that description, the normal full load potential of the alternating-current machines is 235 volts per motor, and in the matter of control it appears that the independent operation of the motors in parallel has been abandoned, probably because of the potential and current requirements, and the acknowledged "necessary and unavoidable" excess of weight in proportion to capacity—the tractive effort attained, even considering the pulsating torque when operating alternating, requiring only a low co-efficient of friction. The motors instead of being independent are, at all times, coupled in units of two armatures with their compensating coils in series, the exciting fields of both machines being external to this combination, and provision is made for coupling the latter in series and parallel relations, also for shunting them with a resistance when in series on direct current.

When operating on alternating current the fields in each group are always in parallel, "to work the iron rather gently" as is so naively stated, and which tells a whole story in itself. The parallel arrangement of the fields is also used when operating direct current under heavy load to keep down the heating.

According to the latest reports, the weights of the two locomotives are about 100 tons for the Central, of which 70 tons are on the drivers, and 85 tons for the New Haven, all on the drivers. Of the Central's weight 30 tons is on the guiding trucks and has nothing to do with the weight of the electrical apparatus. True comparison of weights which can be strictly assigned to the motor equipments in the two types is difficult, but for equal capacity without ventilation it is very much less in the case of the Central.

With 15 per cent traction coefficient, which is all that can be counted on for continuous work, the Central's locomotive should be able to exert a tractive effort of 21,000 lb., and the New Haven locomotive 25,500 lb., if it were not for some unbalancing of wheel pressures, and much more with sand on a dry track. In both machines, however, on account of being uncoupled, when the armatures are in series the drawbar pull with any given co-efficient of friction will be reduced because of the reduction of the pressure on the leading wheels, with consequent tendency to slip them.

By assuming the use of sand, interesting comparisons of performance with special reference to the operating conditions necessarily governing terminal yard movements are indicated in the following typical examples:

(*a*) With 1,000 amperes from line, direct current operation, slow speed, with armatures in series and all resistance cut out:

Machine.	Fields.	Tractive effort.	Speed.
Central	Series	29,200 lbs.	6 miles
New Haven	Series	11,800 lbs.	22 miles
New Haven	Ser. Par.	9,200 lbs.	27 miles

With the same direct-current line current, then, which is well within the capacity of the Central's locomotive, it exerts at its slowest economic speed a tractive effort from two and a half to more than three times that of the New Haven. If thrown into series parallel combination, the Central's locomotives would, with 1,000 amp. from line, develop a tractive effort of 12,600 lb. at 21 miles, but with very much less heat rate than the New Haven.

(*b*) With 20,000 lb. tractive effort, which is practically about the limit of the New Haven machine, direct-current operation, armatures in series and all resistance cut out:

Machine.	Fields.	Current from line.	Current in fields.	Speed.	Time to Rise 75° C.
Central	Series	725	725	7 miles	90 minutes
New Haven	Series	1,540	1,540	14 miles	8 minutes
New Haven	Ser. Par.	1,740	870	19 miles	14 minutes

A tractive effort of 20,000 lb. on alternating-current operation with the New Haven machine is, save momentarily, out of the question, because it would require nearly 2,100 amp. in the armatures, and even at 2,000 amp. the temperature rises 75° C. in the extraordinarily short time of four minutes, and it cannot be kept down.

(*c*) With 18,000 lb. tractive effort, since 20,000 lb., which is only two-thirds that possible to the Central's locomotive at slow speed, is impracticable for New Haven alternating operation. Then with armatures in series we have the following comparisons:

Machine.	Supply.	Fields.	Current from line.	Current in fields.	Speed.	Time to Rise 75° C.
Central	d. c.	Series	665	665	8 miles	105 minutes
New Haven	d. c.	Series	1,420	1,420	19 miles	11 minutes
New Haven	d. c.	Ser Par.	1,620	810	21 miles	18 minutes
New Haven	a. c.	Parallel	C. in arm. 1,900	950	Variable	8 minutes

Of course, these high tractive efforts are for starting, and the locomotives would acquire higher speeds while the motors are in series on direct-current operation. It is, therefore, quite evident that the New Haven locomotive, despite an excess of fully 20 per cent on the drivers, does not approach the Central's in tractive possibilities, and will in yard movements in the direct-current zone require at least double the line current for equal tractive effort. In any case, when operating at slow speeds the controlling resistances must, on the New Haven locomotive, be left in circuit.

Comparison of the heating of the machines when required to be run at slow speed on like duty without ventilation shows an enormous disparity between the two locomotives, and it is safe to say that with equal ventilation a single Central locomotive can on direct-current operation be made to perform an all-round service almost equal to that of the New Haven locomotives on alternating operation. Verily, these latter machines, to quote one of my critics, "cannot turn a square corner, climb a tree, or please" me overmuch, under the circumstances. Moreover, it seems clear that, leaving aside comparison between motors each built solely for direct or alternating-current operation, which cannot but be to the ultimate disadvantage of the latter, the attempt to make the same machine acquit itself with equal satisfaction on either circuit cannot but meet with disappointment.

The Franklin Bicentenary in Philadelphia.

The exercises planned in connection with the Franklin bicentenary in Philadelphia were duly carried out April 17-20, with great èclat. Note was made of the preliminary proceedings last week in these columns. The whole of Wednesday, April 18, was devoted to the consideration of papers on scientific subjects before the American Philosophical Society, three of these papers dealing with electrical subjects on "Positive and Negative Electrons," by Prof. H. A. Lorentz, of Amsterdam; "Franklin's Researches in Electricity," by Prof. E. L. Nichols, of Ithaca, and the "Modern Theories of Electricity and Their Relation to the Franklinian Theory," by Prof. E. Rutherford, of Montreal. In the course of his paper Prof. Nichols said:

"He took up the subject as an amusement. Residing in a remote colonial community and imperfectly acquainted with previous work in electricity, he was compelled to rediscover for himself many of the things which had already been observed in Europe. Franklin's earliest achievement in electricity was his discovery of the power of a pointed conductor to discharge an electrified body when brought near the same, and to prevent the accumulation of charge upon a conductor to which it was attached. Of this property he later made application in the lightning rod. During the summer of 1747 he performed a series of experiments with the Leyden jar.

"He devised the cascade arrangement by which a number of jars can be charged or discharged in series and made condensers of glass plates with coatings of lead—such as are still known as Franklin plates. He also magnetized and demagnetized steel needles and even reversed their polarity by means of the discharge current from his condensers. He constructed two forms of electric motor driven by means of the energy thus stored. With the exception of the lightning rod, these two machines represent Franklin's nearest approach to practical electrical invention.

"No scientific achievement of Franklin's made so profound an impression upon the public of his day as his demonstration that lightning is an electrical phenomenon, and even now nothing is more generally associated with his memory."

"Had the many-sided Franklin been one-sided," said Prof. Nichols, "and that side turned to science, what might he not have accomplished? But then he would not have been our Franklin!"

Prof. Rutherford, in his paper, said: "The theory of electricity developed by Franklin, generally known as the 'one fluid' theory, must be regarded as the greatest of his additions to electrical knowledge, for it has exerted a profound influence on the development of electrical ideas, and, even after the lapse of a century and a half of ceaseless activity in electrical research, still holds its place, though in a modified form, as the generally accepted explanation of positive and negative electricity.

"After a century and a half of great scientific activity, which has added enormously to our knowledge of electricity, the ideas of electricity, which are in vogue to-day bear a remarkable resemblance to those advocated by Franklin in the infancy of the subject. This resemblance must have been obvious to you all in the light of the recent developments which have been touched upon in this paper. We believe that there is one kind of electricity, namely, negative electricity, which is carried in small definite units by the electrons. These electrons are a mobile constituent of all matter and are able to move freely through metals."

On Thursday, April 19, honorary degrees were conferred by the University of Pennsylvania upon a number of well-known men, the list including Mr. W. Marconi, Mr. A. Carnegie, Dr. E. L. Nichols, Prof. A. A. Michelson, Prof. E. Rutherford, Prof. H. A. Lorentz. A degree was also conferred upon King Edward, of England, through Sir Mortimer Durand, the British ambassador. In the afternoon the tomb of Franklin, which generally suffers from neglect, was visited, there being a parade, the firing of guns by the armored cruiser *Pennsylvania* and the placing of wreaths on the grave. The day concluded with a reception of the Philosophical Society at the Bellevue-Stratford Hotel in the ballroom, the centerpiece of the decorations being a kite worked out in electric lamps in red, white and blue.

On Friday an imposing ceremonial took place at the Academy of Music, when Mr. Elihu Root, Secretary of State, on the part of the National Government, presented to the Republic of France, through its ambassador, Mr. Jules Jusserand, the gold medal in memory of Franklin authorized by Congress. The medal is a beautiful piece of work, executed by Saint Gaudens. Mr. Joseph H. Choate at the same function also announced the receipt of the Benjamin Wilson portrait of Franklin just restored to this country by Earl Grey, Governor-General of Canada, and stated that the picture is to be kept in the White House at Washington, probably in the historic East Room.

During the day final papers were read at the meeting of the American Philosophical Society, one of them by Prof. W. M. Davis, of Cambridge, Mass., on Franklin's studies of storm origin, and the other a most interesting description of Franklin as a meteorologist by Dr. Cleveland Abbe, of the United States Weather Bureau..

The official exercises of the week were brought to a close by a magnificent banquet at the Bellevue-Stratford, attended by a brilliant company of 300 scientists, public men, etc., from all parts of the world. Dr. Weir Mitchell read an original poem, one passage of which was as follows:

> A memory only? Nay, for us who find
> Familiar here the impress of his mind,
> Warmed by his thought when glow the evening fires,
> Hearing his genius in the whispering wires,
> More than a memory he seems to tread
> Our streets to-day, the quickest of the dead!

The speakers of the evening included Senator Lodge, Ambassador Jusserand, Sir George Darwin, Mr. Andrew Carnegie and Governor Pennypacker, the general theme of the oratory being the inestimable public services of Franklin as a statesman and philosopher.

CURRENT NEWS AND NOTES.

THE ELECTRICAL CLUB.—The Electrical Club, New York, had its opening on April 21 at the new club rooms over Kalil's Restaurant, 14 and 16 Park Place, and about 75 members and guests inspected the handsome quarters for the first time. The reception accorded every one was most cordial and the entertainment was excellent. The new club promises to afford an agreeable place for the gathering of electrical men at midday, and the cuisine, lounging and smoking rooms, etc., are as good as those found anywhere down town.

WIRE IN AUSTRALIA.—The Australian demand for wire continues very active. Prices of telephone wire are hardening with the great demand. One requirement will be 1,000 miles of wire by the Australian Government for a new system between Sydney and Melbourne. Extensions to Brisbane, Victoria and New South Wales will also be made.

SEARCHLIGHTS FOR SHORE.—A new departure proposed for the life saving service on the Long Island coast is the introduction of powerful searchlights. Three stations have been already provided with these searchlights, which will enable the crews to work on the darkest nights. It is expected that within a short time all the stations will be equipped with the lights. One difficulty is to render electricity available on the long stretch of beach that forms the southward rampart of the Great South Bay. It is at most points several miles from the mainland.

QUADRUPED POLE CLIMBERS.—Monkeys and woodpeckers, with occasional snakes, have been known to do serious damage to telegraph circuits, and new troubles of the same kind are reported. Telegraph companies in South Africa have trouble with wild giraffes. Recently there was an interruption of the service on the Victoria Falls line. Investigation showed that a herd of giraffes became entangled by their necks in the wires at Intundhia, 125 miles from Bulawayo, and pulled about a mile down, breaking three of the iron poles. In other instances of breakdown elephants were responsible through a misunderstanding of the phrase "trunk lines."

CABLE TO CHINA.—Messages of congratulation were exchanged on April 16 between President Roosevelt and the Dowager Empress and the Emperor of China on the completion of the last link of the Commercial-Postal cable into Shanghai, from Manila, thus connecting the United States with the Celestial Kingdom. The completion of the cable between Manila and Shanghai finishes the transpacific line, which was begun several years ago. The first stretch of cable was laid between San Francisco and Honolulu. The line was later extended to Manila by way of Guam and Midway, and finally to Shanghai. Nearly 10,000 miles of cable have been laid in an average depth of 2,640 fathoms. The greatest depth found on the line of the cable was 3,490 fathoms, approximately four miles.

CANADIAN WATERWAYS COMMISSION.—Advices from Toronto state that the report of the Canadian section of the International Waterways Commission has been made public. It declares the maintenance of Niagara is a national affair and should be dealt with as such. The United States Secretary of War has enforced rules and regulations upon American companies which the commission will probably use as a foundation for regulations to be ultimately recommended to the two governments. The whole question of riparian rights in relation to navigable streams or international waters will most likely have to be adjudged by some treaty arrangement between the two countries. The commission passed a resolution asking that no further rights or privileges be granted regarding the water flowing out of Lake Superior.

AN INDUSTRIAL TOWN.—The New York *Herald* of Sunday, April 22, devotes a column to a description of Kinkora, an industrial town being built on the Delaware about twelve miles below Trenton by the Roebling Company. It is stated that about $4,000,000 will be expended for providing almost ideal homes for the men employed in the Roebling Works. The streets will have a width of 100 ft., a parkway running through the center bordered with shade trees. A hotel conducted on the plan of a private club and department store are among the features. Other buildings contemplated are an assembly building, a school house and perhaps a church. The hotel will have a model bar. Six hundred houses will soon be constructed, which will be rented for $9 a month. Other houses will rent at $8 a month and $14 a month. The Roebling Works at Kinkora will employ about 3,000 men.

CHINESE TROLLEY PROJECTS.—United States Consul Smith, of Victoria, B. C., reports the first strictly Chinese project to build an electric railroad line. He states that Mr. Lim Dat, a successful Chinese merchant of that city, has organized among his countrymen located in British Columbia a $2,000,000 company to construct an electric trolley railway in China from Canton to San Wu, a distance of 60 miles. No white men need apply for stock, as their presence in the company would forfeit the charter from the Chinese Government. The route of the proposed line is a populous one, Canton having a population of 2,000,000 and San Wu 500,000. The prospectus of the new company sets forth that there are no serious topographical difficulties to be encountered in building the line; that water power will be obtained from the Quai Tong Shun Mountains, 30 miles from San Wu; that now there are 22 junks plying on the river between these points, carrying heavy cargoes and many passengers; that it takes these junks 14 hours to make the trip, which the electric cars will make in 3 hours. It is also stated that the summer cars to be operated—the climate being warm—will each be equipped with 50-hp motors. The plan is to build the line entirely with Chinese labor, even using Chinese electricians as far as possible. It is stated that the company also intends to seek from the city of Canton a concession of the light and power privileges. The streets there are so narrow that some difficulty would be experienced in attempting to secure the franchise for a city street railway system, although this may be sought later. Mr. Lim Dat is at the head of the leading Chinese mercantile firm in Victoria, known as "Gim Fook Yuen." They own a large brick block, conduct a department store, a rice mill and have several other stores in British Columbia, as well as a branch house in China. Mr. Dat, in 1895, invented and secured a patent on an improved device for electric rice mill machinery, the first patent issued to a Chinaman in British North America.

A NEW CUNARDER.—The electric installation to be fitted on the Cunard steamer *Mauritania,* will be the largest and most complete ever fitted on board such a ship. The generating plant consists of four sets of Parsons turbo-generators and each machine will be capable of producing 4000 amperes at 110 volts. This machinery will be placed in the aft end of the engine-room in two separate compartments divided by a watertight bulkhead, and arranged in such a way that the ship would remain lighted in the event of either engine-room being flooded with water. There will be two switchboards, one in each compartment, for distributing electricity throughout the ship. A large portion of the auxiliary machinery will be driven by electric motors, including sixteen forced draught fans of fifty horse-power each for the stokeholds, and about sixty horsepower for the refrigerating machinery. Two electric passenger elevators are to be fitted for conveying passengers between the six decks, and also six smaller elevators for the conveyance of stores, mails, etc., and two large luggage hoists. Electric motors are to be fitted for raising and lowering the lifeboats, heaving in the sounding line, and for driving various machines in the bakery, galley, and pantry. In connection with the ventilation of the ship there will be about sixty large electrically-driven fans, including thermotanks, for heating and ventilating the whole of the passenger accommodation. The electric lighting of the ship will require about 5000 lamps of sixteen candlepower, which is more than double the number fitted on the steamer *Cedric.* In the staterooms de luxe there will be three lamps for lighting each room, electric fan, electric curling tong heaters for the ladies, and an electric radiator for heating the room independent of the general system. In addition to the usual electric bell system, there will be a telephone exchange fitted in connection with the first-class rooms and the principal officers of the ship, and special telephones from the bridge to the wheel-house aft, the forecastle head, and the engine-room. On the bridge deck there will be four powerful searchlights, and there will be two mastheads and two side lights, fitted with electric duplicate apparatus which automatically replaces a broken lamp filament, at the same time signalling to the officer on watch that such has taken place. In addition to this, the steam whistle will be electrically controlled, and all the watertight doors throughout will be closed automatically by electric connection from the bridge.

TELEPHONES FOR AUSTRALIA.—The fiscal authorities of Australia note that a drawback duty will be allowed on telephone parts used for manufacturing telephones.

OHIO RAILROAD DILEMMA.—The steam railroads of Ohio have been operating for some time past under a law limiting fares to two cents per mile. They state that it means operation at a loss, and various plans of relief are under discussion, and one of these is a general resort to electric traction or the use of gasoline-electric cars.

COST OF SUBWAYS.—The Rapid Transit Commission of New York received last week from the Commissioner of Accounts a letter asking for a detailed statement of the bonds which would be required for new subways this year and for the amount of bonds that would be required for all of the routes laid out. A reply was sent stating that the lines laid out for Manhattan will cost $175,000,000, those for the Bronx $46,000,000, and those for Brooklyn $97,500,000, a total of $318,500,000.

NIAGARA POWER.—At Albany on April 20, Governor Higgins approved the bills introduced by Senator L'Hommedieu, repealing the special charters of the Lockport Water Supply Company, the Lewiston Water Works, the Lewiston Water Supply Company, and the Buffalo & Niagara Power & Drainage Company. All are said to be inactive corporations. On the same day in Washington, Senator Platt of New York presented a memorial from the board of trade of Niagara Falls, remonstrating against the Burton bill to prevent the taking of water from Niagara River for power purposes.

CATCHING THE PUBLIC EYE.—The Boston Edison interests, now in control of the Natick Gas & Electric Company, have made clever use of the old 100-ft. chimney at the distributing station. The company solicited bids for tearing the structure down a little while ago but the cost of the work was considered too high and it was determined to use it. The chimney has been painted white and on three sides "Edison Light" appears in large black letters. On the front seventy-five 16-cp incandescents have been arranged for an electrical sign, "Use Edison Light," which illuminates the entire neighborhood. It makes an attractive sign.

A TELEPHONE REPEATER.—A special telegram from San Francisco of April 16 says: "David C. St. Charles, an engineer of this city, has invented a repeater, which will make it possible, he claims, to telephone from here to New York. What the so-called "repeater" has done for telegraphy, St. Charles's invention is intended to do for the telephone. The combining of the echo in nature with the sounding board of a violin furnished the clue to the discovery, according to a statement of the inventor. The superintendent of the local telephone company says that the invention is a success." Mr. C. J. Glidden, the well-known telephone financier, has virtually offered, in our pages to put up a million dollars for such an invention, if practicable.

WIRELESS IN CHINA.—U. S. Consul-General Ragsdale writes from Tientsin that the Chinese Government has arranged to establish several stations throughout China for experiment with Marconi's system of wireless telegraphy and instruct Chinese operators in working the same. The apparatus has been installed on four Chinese men-of-war at Shanghai and at the three north China cities of Tientsin, Peking, and Paotingfu, the radius of action being about 230 kilometers and the cost about 25,000 taels. An Italian officer has been appointed, not only as instructor, but also as engineer to superintend the installation. Under his supervision a number of students have already been detailed to act as operators and learn the art of management. It is also said that the viceroys throughout the Empire have been directed to consider the advisability of establishing other stations to work in conjunction with those above mentioned.

AN ADVERTISING EXPOSITION will be held at Madison Square Garden, New York, from May 3 to 9, inclusive. The show will be under the management of George F. Parker and J. L. Bieder, of 116 Nassau Street, New York, who gave a similar show at the Coliseum, Chicago, last fall, when it attracted nearly 200,000 people. The exhibitors will include publishers and advertising agencies who will set forth to all visitors the importance of newspaper and magazine advertising; printers and lithographers who will show the value of their various products and methods of manufacture; calendar manufacturers will exhibit specimens of calendar advertising; novelty manufacturers and dealers will put on view novelties of various kinds; sign manufacturers will show the value of indoor and outdoor signs.

CUBAN CABLE.—The following bill is in progress in the U. S. Congress, having passed the Senate already: "The secretary of war is hereby authorized to construct, and thereafter maintain and operate for governmental and commercial purposes, a submarine cable from Key West, Florida, to the United States naval station at Guantanamo, Cuba, and from there to the Canal Zone, on the Isthmus of Panama; and for the purpose of carrying the foregoing provisions of this act into execution the sum of $927,000 or so much thereof as is necessary, to be immediately available, is hereby appropriated: Provided, that in connection with the installation and operation of such cable system the Secretary of War is authorized and empowered to utilize, if consistent with the public interest, the personnel and resources of the military establishment, as far as they can be advantageously used without detriment to the public interest, and to employ such experts and other persons as may be deemed necessary to assist in carrying into execution the provisions of this act."

MONORAIL AGAIN.—Mr. F. B. Behr, whose electric monorail system has been so long before the public on the other side of the Atlantic without any practical results, appeared last week before the New York Aldermanic Committee on Railroads, and advocated the use of his system in Brooklyn, with a three-cent fare. Mr. Behr wants the initial or test line constructed from Atlantic and Flatbush Avenues, in Brooklyn, via Fourth Avenue to Fort Hamilton and Coney Island. The cars would run on a single rail laid on top of an "A"-shaped structure along the sides of which would run the feed rails. The system could be built either as an elevated line or as a Subway. His general plan, of which the Coney Island line would be but the first step, would be for a line from Tottenville, S. I., running through the island under the Narrows by tube to Fort Hamilton, through Brooklyn to Borough Hall, and thence under the East River to Manhattan and north to the Bronx or Kingsbridge. The entire line would be thirty-five miles long, and, with the branch to Coney Island, would cover forty-six miles. Mr. Behr states that the cost of building an equipment for use would be $86,000,000.

TELEPHONY IN NEW YORK.—A hearing as to telephone rates in New York was had last week by the Aldermanic Committee on Laws and Legislation. Mr. A. R. Conkling spoke in favor of the adoption of a five-cent interborough telephone rate. Mr. Reynolds, president of the Great Eastern Telephone Company, spoke in favor of the establishment of an independent telephone system. While not urging the establishment of a municipally owned system, Mr. Reynolds asserted that the city could run such a system on a two-cent per call basis and make money. The committee said they would take the matter up and report to the board later on. Mr. Martin Littleton, as counsel for the Atlantic Telephone Company, has sent a letter to the Board of Estimate, asking for the appointment of a sub-committee of the board, or of engineers acting in its behalf, to investigate the workings of the automatic telephone system which the Atlantic Company proposes to use if it gets its franchise. The company wishes to have the committee visit other cities to see the workings of the automatic telephone exchanges. By the recent ruling of corporation counsel, the Great Eastern Company has no franchise under which to operate in the present tripartite fight.

A New North Italian Hydro-Electric Power Plant.

ANOTHER interesting hydro-electric power plant has just been completed in North Italy at San Giovanni Bianco for the transmission of power to the Lecco and Erba district in Lombardi, the seat of large manufacturing interests. Water is taken through a canal 4½ miles long from the Brembo River at San Pellegrino. At this place there is a dam on the "Poiree" system having a length of 156 feet. The canal has four underground sections, one of which is nearly a mile in length. The generating station (Fig. 1) is in the Brembo Valley about a mile from Zogno. The reservoir in which the canal ends is shown above the station, with which it is connected by steel conduits.

In the generating room of the station are installed four 2,000 hp turbines (Fig. 5) of the Francis type and constructed by Riva, Monneret & Co. of Milan. These are rigidly coupled to three-phase alternators made by Gadda, Brioschi, Finzi & Co., Milan.

FIG. 3.—CEMENT BUS-BAR COMPARTMENTS.

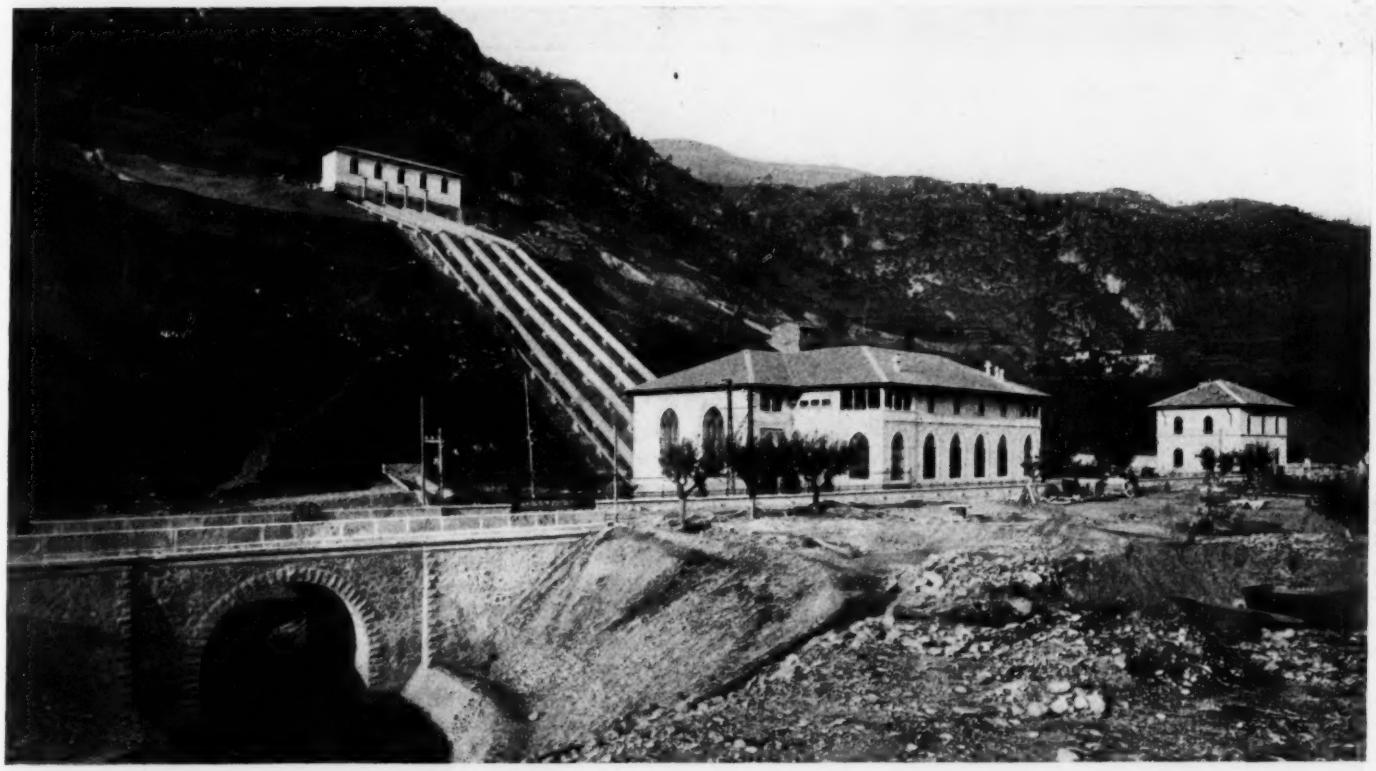


FIG. 1.—GENERAL VIEW OF ZOGNO HYDRO-ELECTRIC POWER STATION.

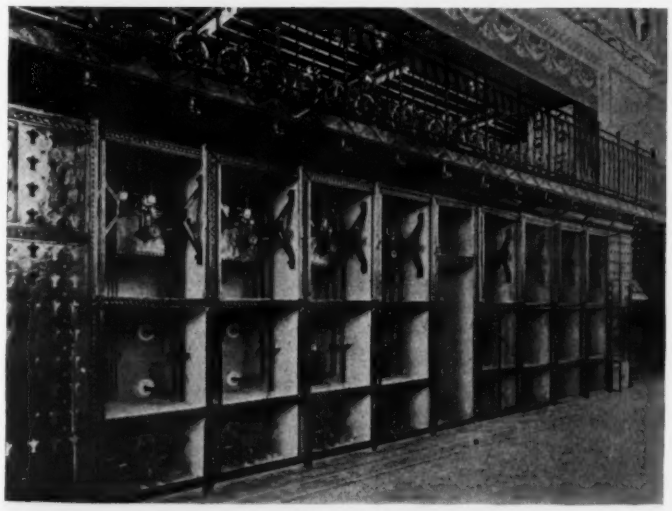


FIG. 2.—CEMENT SWITCH COMPARTMENTS.

The alternators are of the revolving field type with fixed armature having removable windings composed of form wound copper plates. In case of damage an armature winding can be rapidly replaced even by workmen not accustomed to this kind of work. The revolving field frame is laminated so as to form a ring of great mechanical strength. Upon the projecting poles there are dampers consisting of copper plates spirally wound and held in position by bronze bars which form a bridge from pole to pole. Each set is rated at 1,800 kw, and will develop 400 amperes at 2,700 volts and power factor of .75. The speed is 315 r.p.m., corresponding to a frequency of 42 cycles. The journals are fitted with water cooling devices to reduce the temperature of the lubricating oil.

The exciting current is furnished by two small turbine sets of 150 hp each, the two machines of a set being flexibly coupled. Each is capable of delivering 950 amperes at 110 volts at a speed of 75 r.p.m., and one set is more than sufficient to energize three alternators at full inductive load. The voltage generated (2,700 volts) is raised by means of four sets of transformers to 25,000 volts for transmission. Each set of transformers is rated

at 800 kw and consists of three single-phase transformers of the air-cooled type. Each has its own air fan operated by a small motor.

In the station a series of cells (Figs. 2 and 3) of armored cement contains the apparatus, the bus-bars and the 2,750-volt

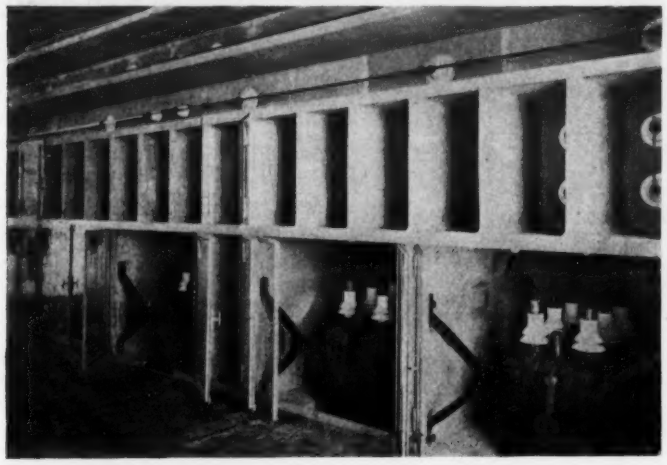


FIG. 4.—HIGH-TENSION SWITCHES.

conductors. A second group of cells contains the instruments and the 25,000-volt connection (Fig. 4). Above, supported by a steel ceiling, is the controlling room (Fig. 6), containing a cast-iron board divided into seven compartments. The central compartment contains the line ammeters and the general voltmeter. Four other compartments correspond to the four generators, the two last being for the respective transformers. Six small pillars of cast iron carry the devices for operating the 25,000-volt switches. At one end of the controlling platform is the switchboard for the exciters, and at the other is the totalizing watt-hour meter. No high-tension wires connect to the board, all the measuring and safety apparatus receiving current through suitable transformers.

Following up the conductors or "leads" from the machines to the transformers, there are first, from the alternators three single-conductor lead-encased cables to the corresponding cells.

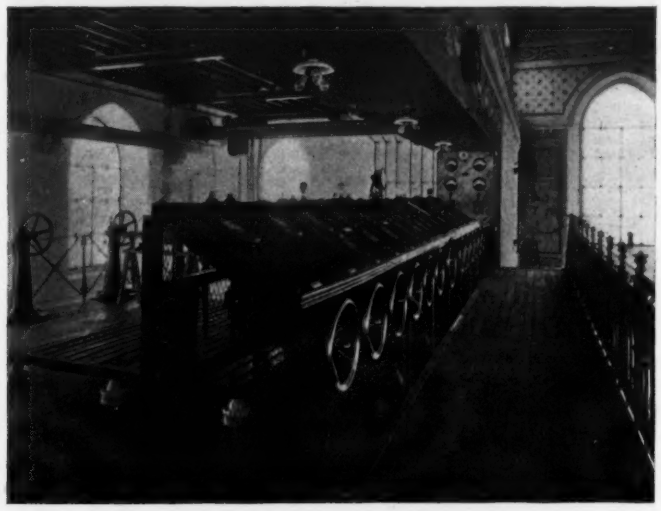


FIG. 6.—VIEW OF SWITCHBOARD GALLERY.

Two cables pass to current transformers (for the maximum relays), and one to a transformer for the ammeter. The leads then continue upwards to the air-blast raising transformers, the secondaries of which are connected to automatic three-pole oil switches, and thence to the high-tension bus-bars.

The same course is followed by the leads running from the bus-bars to the four groups of three-phase 1,800-kw transformers. Time relays are applied to all the automatic switches at the central station, which only operate when a small safety fuse arranged in parallel with the relay has blown.

As stated before, the generator e.m.f. of 2,750 volts is increased to 25,000 volts for transmission by groups of single-phase transformers. In these transformers the external magnetic circuit

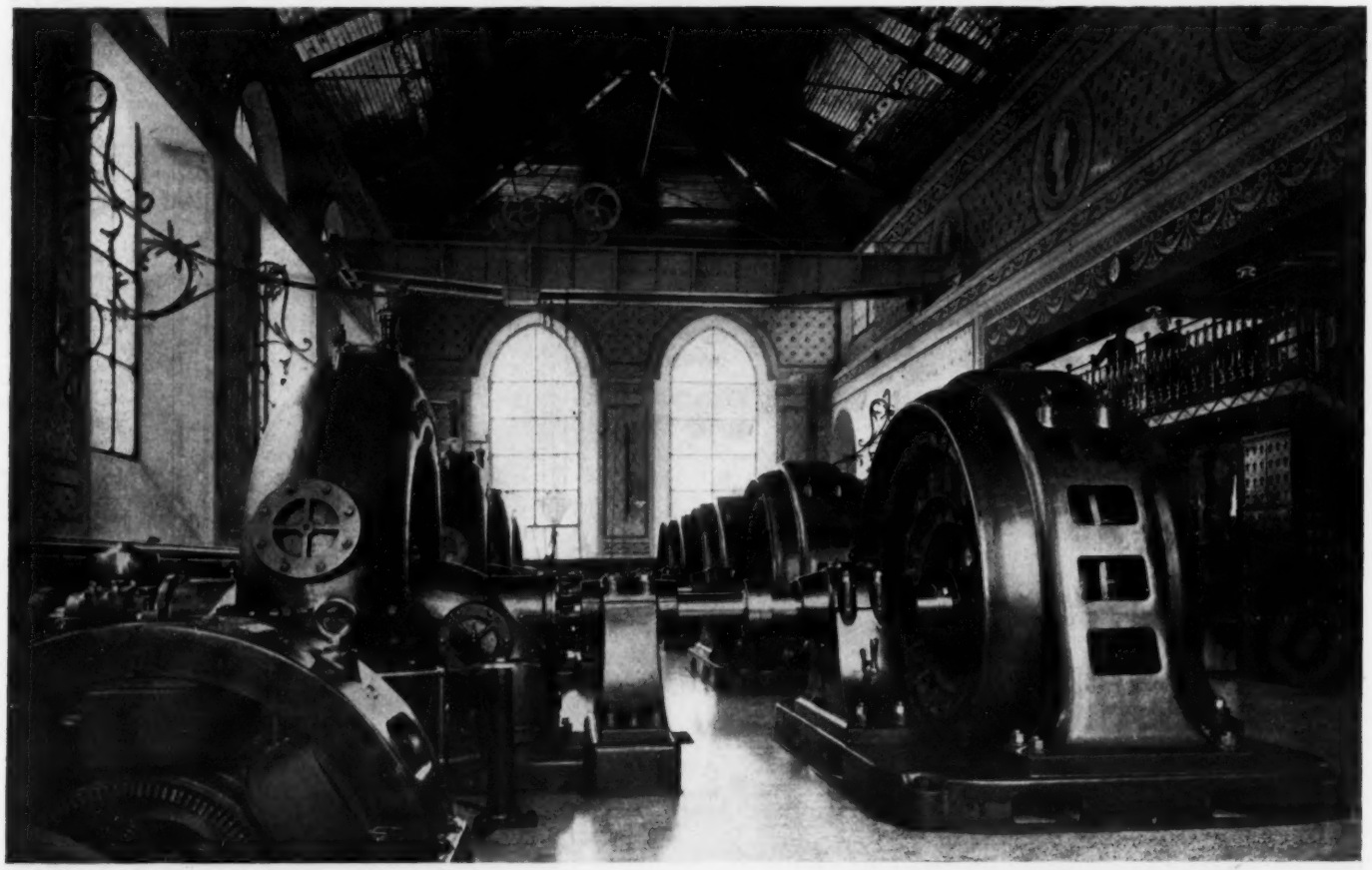


FIG. 5.—VIEW OF INTERIOR OF CENTRAL STATION AT ZOGNO.

protects the winding mounted upon the central core and formed of alternate coils arranged vertically. They are of the air-cooled type with forced ventilation, obtained by means of suitable ventilators coupled to electric motors. The air, guided in suitable conduits placed beneath, enters into the body of the transformer passing over the whole surface of the coils, and then escapes at the top. Messrs. Gadda, Brioschi Finzi & Co. have adopted this type for high-tension work and for the large units, as the construction combines great mechanical strength and the best utilization of the ventilation.

The twelve transformers are mounted in line upon a base of

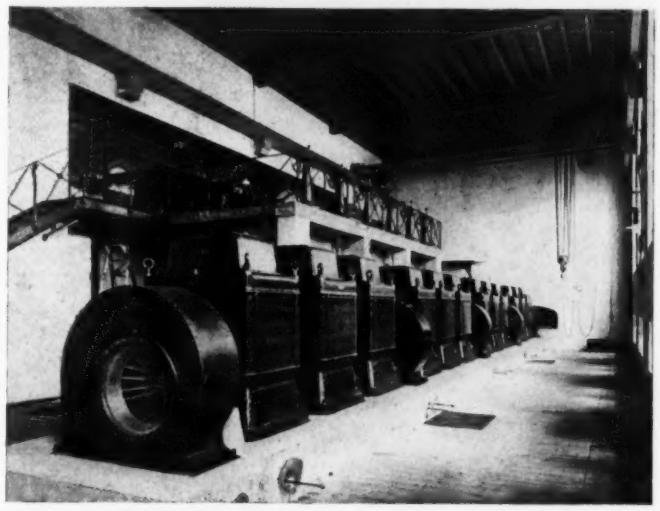


FIG. 7.—GROUP OF AIR-BLAST TRANSFORMERS.

cement, behind the high-tension cells. In this way the connections are reduced to a minimum and are well protected. The high-tension mains leading from the four units are connected across switches and separators to a system of bus-bars to which the two outgoing lines are connected. By the system of conduits and cells adopted a transformer room has been obtained without an exposed wire. The lightning arrester room, which is on the upper floor, is built up with cement cells or chambers. The Gola, Siemens and Wurts arresters used are separated pole by pole by means of cement walls.

The transmission line is in duplicate and each is divided into two sections at a switch cabin, in which it is possible to connect up the two lines, or, in case of necessity, to throw out of service any one of the four sections. The operation can be effected without interrupting the service by means of switches located in cells of reinforced concrete, of the same type as that adopted in the central station. The switch cabin is connected to the generating station and to the substation by means of a telephone line.

Massie Wireless Telegraph System.

OUR issue for July 29, 1905, contained a complete description of the operating characteristics of the Massie system of wireless telegraphy, and many of the constructive features of the apparatus employed were mentioned at that time. It is believed, however, that the equipment as used at the present time possesses a sufficient number of interesting improvements in details to justify a more extended discussion.

The operating circuits of the Massie system are arranged in three distinct, although somewhat interconnected, groups. These groups may, for convenience, be designated as the transmitting, the detecting and the receiving, respectively, each of which is designed so as best to perform its particular function. Thus the transmitting circuits are arranged so as to allow of the production of the most effective electrical ether waves with the least expenditure of power; the detecting circuits are adjusted to announce at the receiving station that the sending station wishes to transmit a message, while the receiving circuits are arranged for the most effective results in interpreting the message.

A special controlling switch allows either one of the three groups to be used as the operator may desire. When the apparatus at a certain station is in active use, the switch is so constructed that the aerial will be connected to the receiving circuit or disconnected for transmitting, as the case may require. At all other times, however, the aerial is connected with the detecting apparatus, which contains a bell alarm in a relay circuit, so that the operator is relieved from the tedious task of "listening

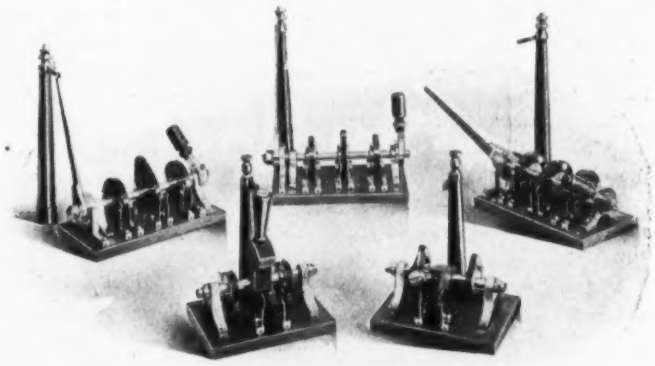


FIG. 1.—MAIN CIRCUIT-CONTROLLING SWITCHES.

in," and yet no messages intended for the station will be overlooked. The switches employed vary somewhat in design according to the character of the stations at which they are used.

Views of circuit-controlling switches for high-power land and ship stations and for low-power portable sets are shown in Fig. 1, while a controlling switch in active service with a portable set is indicated in Fig. 2. To use the powerful transmitting ap-

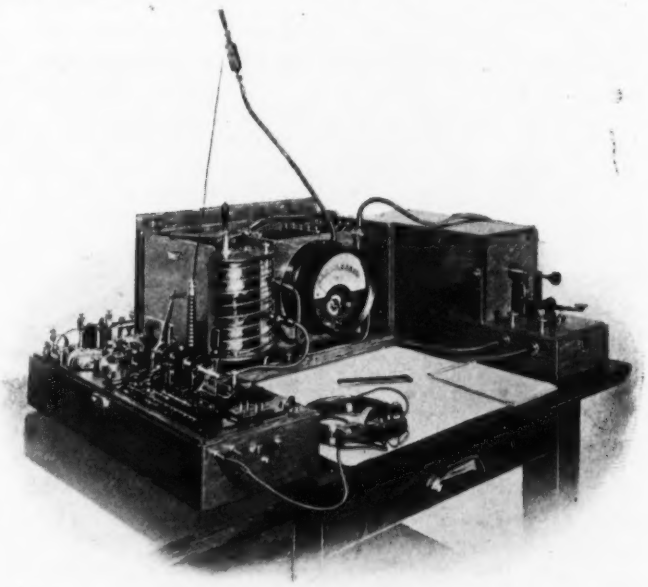


FIG. 2.—COMPLETE PORTABLE SET.

paratus the switch must be placed in such a position that the delicate receiving equipment is entirely separated from the aerial and effectively insulated therefrom, the battery circuits must be broken and the detectors short-circuited and grounded; when the switch is changed so as to put the receiving apparatus in an operative condition the transmitting circuit is broken. Thus the switch device effectively protects all the apparatus by making it impossible to send while the receiving circuits are closed and vice versa. The aerial connected to the receiving apparatus is separated from the transmitting apparatus by means of an insulated microscopic air-gap termed an "anchor gap," in the transmitter circuits; otherwise the antennæ would be grounded through the inductance of the transmitting apparatus. Although this small gap is sufficient to insulate the vertical when receiving, it is practically a short-circuit for the high-tension oscillations produced when transmitting.

The transmitter equipment includes the usual spark-gap, inductance coil, condenser, high-potential transformer, interrupter, when direct current is used, and source of energy. Each of these parts possesses features of construction deserving special mention. The spark-gap is surrounded by a micanite tube, fitted with a window, which serves to deaden the excessive noise from the disruptures and yet allows the gap to be inspected at any time. It is placed within the inductance coil, as shown in Figs. 2 and 3. The inductance of the coil may be varied by shifting the position of the connecting terminal along the turns, so that, in connection with the proper capacity in the condenser, the transmitting circuits may be adjusted to give forth any desired length of electrical wave. The turns on each coil are carefully calibrated and the inductance for each position of the sliding terminal is indicated on the framework, while the mechanical mounting of the coil is such as to allow any desired inductance to be found at once by merely revolving the coil.

As a table giving the capacity of the condensers is also furnished, the operators can easily determine the wave lengths by the following formula:

$$\lambda = 2\pi V \sqrt{LC},$$

where λ = wave length,
V = velocity of light,
L = inductance,
C = capacity.

Difficulty has frequently been experienced in causing a spark-gap to operate continuously and to repeat its performance indefinitely, a gradual change usually taking place in the behavior of the gap. This change has been attributed to the heating and to the ionizing of the air surrounding the gap, and a remedy for the difficulty has been found in cooling the terminals of the gap and removing the air from the immediate neighborhood. In his latest equipments Mr. Massie builds the air-gap terminals of tubing through which air is forced under pressure. The terminals themselves are cooled by the expansive action of the compressed air, while the ionized particles are removed before they have accumulated in sufficient quantities to affect the operation of the gap by exhausting the expanded air through small openings in the ends of the rods. The expanding compressed air is also allowed to flow through the hollow turns of the inductance coil in order that the coil may be kept at a temperature lower than that which would otherwise be produced in the windings by the high-frequency currents. Needle valves control the admission of the compressed air to the inductance coil and the spark-gap rods; an electromechanically-operated valve in the main supply pipe is connected to the main controlling switch, so that the valve is opened when the transmitting circuits are in use and is closed at all other times.

A condenser for an 8-kw station set is shown in Fig. 3. The condenser is built up of plates of glass on which are secured sheets of tin-foil. The connections are so made that the glass itself becomes the dielectric, and the air is not depended upon either for insulation or for inductive capacity. Each glass plate with its two sheets, therefore, possesses a definite capacity, and the capacity in circuit depends upon the number of plates in use. The immediately near sheets of adjacent plates are connected together by means of a spring contact inserted between them. These contacts are mounted on rods, and the alternate rods are joined in groups to bus-bars, so that the active capacity of the condenser depends upon the number of rods which are "in" or "out." Since the air space separating adjacent plates is not subjected to any difference of potential, there is no possibility of a disruptive discharge between these plates. A leakage path through air is found, however, over the exposed sides and edges of each glass plate. For the purpose of improving the insulation and preventing the formation of corona, all of that portion of the glass not covered by the tin-foil and a limited section of the coil is given a coating of asphaltum varnish. This material is intended solely as an insulator and it contributes in no way to the inductive capacity of the condenser. It is used in preference to other varnishes as brush discharge is reduced to a minimum, thus producing a more defined period of oscillation and therefore sharp and true wave lengths.

The transmitting key is in each case similar to a telegraph sender key, and the apparatus is of such a nature that any one familiar with the Morse alphabet can send messages without additional instructions. With a small portable or boat set the key is connected directly in circuit with the primary of the high-

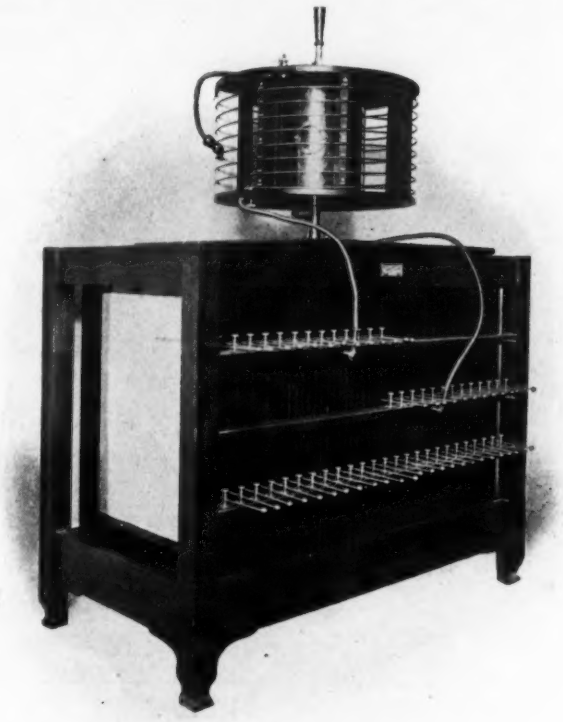


FIG. 3.—CONDENSER WITH INDUCTANCE COIL AND SPARK-GAP.

potential transformer; as shown in Fig. 4. When the energy is obtained from a battery or a direct-current generator a mechanical interrupter is also inserted in the primary circuit, but when alternating current is used the interrupter is omitted. In a high-power land station where the heavy currents would tend to destroy the key, unless an extremely large and unwieldy one were used, the key is used merely to close a battery circuit to an elec-

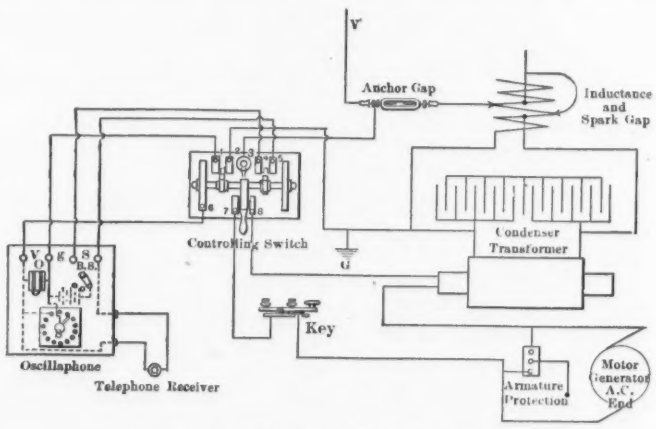


FIG. 4.—DIAGRAM OF BOAT SET.

tromagnetically-operated oil switch in the primary circuit of the high-potential transformer. (See Fig. 5.)

The Massie detector is of the filings coherer type. Its most prominent feature is its sensitiveness, which may be attributed largely to the mechanical arrangement of the parts. The main axis of the device is placed in the vertical direction, so that the force of gravity assists in the action of the coherer. The coherer consists of a magnetized needle with its lower end supporting magnetic filings immediately above a mixture of non-magnetic filings—the former being of iron and the latter of silver. The filings are placed in a silver-lined cup which forms one terminal of the coherer, the magnetized needle being used as the other ter-

minal. The needle causes the iron filings to be arranged in line just above the silver filings, with a minute film of air between them, thus forming an electrical path of high resistance. The effect of an electrical oscillation is to cohere the filings and to decrease the resistance and thus to allow a current to flow from a battery circuit through the coherer and a relay which in turn operates a bell alarm and a tapping device, which latter decoheres the filings and restores the resistance to its normal high value. The main features of this coherer were discussed in the article referred to above. On a flexible brass strip is securely mounted the silver-lined cup, and to this is fastened a substantial glass tube which serves for holding the needle in place. The tapper strikes against the brass strip, but does not come in contact with the glass tube so that the breaking of a tube by the tapper is unknown. The filings are completely enclosed and the performance of the coherer is not affected by atmospheric changes, while the effect of external mechanical disturbances is negligible. When cohered the resistance is less than 50 ohms, often being less than one ohm, thus an inexpensive relay can be used, which is an important factor in the cost of manufacture. The coherer with its bell alarm remains in circuit at all times when messages are not being transmitted or received, and to it is given the task of announcing when a distant operator wishes to communicate with the home station. Sensitiveness, simplicity, reliability and immunity from derangement are prime requisites for such a device, and this coherer seems to fulfill these requirements successfully.

After the coherer has announced that a message is to be sent from some distant station, the operator at the home station moves the main circuit-controlling switch so as to connect the aerial to the receiving apparatus. The predominating feature of the receiver is its ability to withstand rough treatment. It is of the microphonic type, and, mechanically considered, is extremely simple. The "oscillaphone," as the inventor terms the device, consists of a steel needle held in contact with two sharp edges of carbon by means of a small permanent magnet. The terminals of the oscillaphone are formed by the two carbon compound (carbon and paraffin) strips. The resistance of the two contacts between the carbon edges and the needle is normally about 40,000 ohms. When the contacts are included in the aerial circuit, the resistance decreases to less than 1,000 ohms, while electrical oscillations are being received, and it then automatically increases to its initial value when the oscillations cease. The oscillaphone is connected simultaneously in series in the aerial circuit and in a local battery circuit containing an ordinary telephone receiver wound to 1,400 ohms resistance, in order that the signals may easily be interpreted. The loudness of the signals received is adjusted by means of variable resistance inserted in series in the local battery circuit or in shunt to the oscillaphone; the effectiveness of the adjustment is ascertained by the use of a miniature electric wave producer which consists of a pocket-size primary cell connected to a magnetic make-and-break contact device, so that the operator need not depend upon signals from other stations for testing the effectiveness and sensitiveness of the oscillaphone.

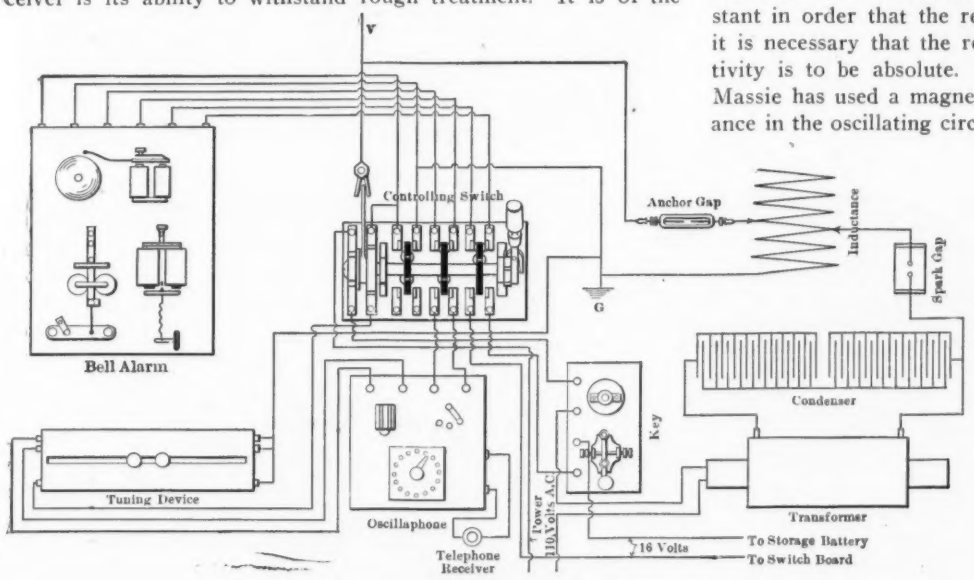


FIG. 5.—DIAGRAM OF LAND STATION.

For the purpose of eliminating from the oscillaphone such messages as may not be intended for the particular station in question, an inductance coil is used in series with a condenser, the inductance and the capacity being so adjusted as to render the combined circuits resonant at the single frequency selected for this station. It is stated that messages which differ in frequency as much as 20 per cent from that for which the receiving apparatus is adjusted will not affect the oscillaphone. The resonant frequency depends largely upon the inductance and the capacity, and it varies only slightly with the resistance in circuit; the sharpness of the tuning, however, depends to a great extent upon the resistance. It is desirable, therefore, that the resistance be constant in order that the resonant frequency may not change, and it is necessary that the resistance be small in value if the selectivity is to be absolute. In some of his latest equipments Mr. Massie has used a magnetic type of receiver in which the resistance in the oscillating circuit is constant and of a negligible value.

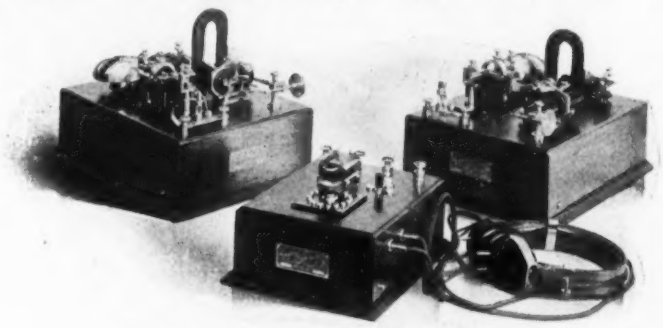


FIG. 6.—BELL SETS AND OSCILLAPHONES.

In this device the telephone receiver circuit is inductively related to the oscillatory circuit. Through the common magnetic paths of the two circuits is moved slowly an iron wire which has been subjected to the influence of a permanent magnet. When a high-frequency current flows in the oscillatory circuit the iron wire suddenly loses its magnetism, and the great rate of change of magnetic lines interlinked with the telephone receiver circuit generates therein an e.m.f. which causes the production of a sound in the receiver. The "iron wire" which is built up of overlapping and concentrically arranged spirals of wire, is moved along the face of the permanent magnets and through the coils by means of a driving mechanism similar to that used in a phonograph. The tuning obtained is claimed to be remarkably sharp and complete.

That the Massie apparatus has passed beyond the experimental stage will be appreciated when it is known that the United States Navy has obtained two 15-kw, two 10-kw, three 5-kw and three 3-kw sets; one of the 15-kw sets is being installed at the Washington Navy Yard, the other will be installed at the Brooklyn Navy Yard and the eight sets, ranging in power from 3 to 10 kw, are for the Pacific Coast. Previous to this contract the Massie Company installed for the United States Navy a 3-kw set at Cape Henlopen, Del.; a 5-kw set at Beaufort, N. C., and a 5-kw set at Charleston, S. C. The United States Signal Corps has obtained two portable sets, while three sets are being used by the Coast and Geodetic Survey. The boats of the Fall River, Providence, New London and New Haven Lines are equipped with Massie wireless apparatus. In addition to the above, commercial land stations are located at Block Island, R. I.; Point Judith, R. I.; Wilson Point, Conn., and Cape May, N. J.

Atmospheric Electricity and Trees.

By Prof. A. G. McAdie, U. S. Weather Bureau.

I. Effect of Sunshine on Transmission of Wireless Messages.

In 1897, during the experiments made by Marconi, Slaby and others in wireless telegraphy, it was noticed that more favorable results were obtained in the transmission of electromagnetic waves over sea surfaces than over land. Moreover, if trees stood in front of or near the transmitting devices the messages were received with difficulty. In Marconi's long-distance experiments in 1902, it was evident that transmission at night was more effective than during the day. It was possible, for example, to send 1,500 miles at night when with practically the same adjustment the limit in the daylight was about 700 miles. This difference Marconi attributed to the discharging influence of sunlight upon the vertical wires. It will be remembered by those familiar with the experiments of Hertz, that he noticed the influence of light upon the terminals of the discharge knobs. Unless the discharging surfaces were kept highly polished, the breaking down of the air-gap was gradual. Minute roughnesses, dust, etc., caused a rapid loss; and ultra-violet light falling on the vibrator prevented its proper working. Indeed Hertz mentions that the knobs of his vibrator had to be cleaned every fifteen minutes. The experiments of Elster, Geitel, Wilson, and others have been based largely upon this principle of the discharge of highly electrified bodies, by sunlight. In the experiments aboard the *Carlo Alberta*, the disturbing influence of sunlight was again plainly demonstrated, and Lieutenant Solari showed that while sunlight lasted, a greater expenditure of energy was necessary.

Perhaps the most noteworthy paper lately written in connection with wireless work is that of Major George O. Squier, U. S. Signal Corps, upon "The Absorption of Electromagnetic Waves by Living Vegetable Organisms," published in December, 1904. In this paper, there is discussed the action of trees as conductors of electricity and the possibility of using trees as receivers of wireless messages. In a number of experiments, Major Squier has utilized trees as receiving stations.

An illustration of some of the experiments is given in Fig. 1, in which *N* and *P* are nails driven into a tree; *M* a microphone or receiver. In these experiments a small ebonite tube filled with carbon dust and having two steel needles nearly touching was used. *T* is a telephone and *B* a battery. The transmitting coil gave a 4-in. spark; the wave length employed was about 300 ft. (91.4 meters); and the frequency in free space about 3.27×10^8 per second.

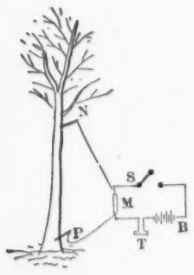


FIG. 1.—TREE AS WIRELESS RECEIVER.

It was shown that a marked difference in efficiency was noticeable with various trees, and that a tree with a small amount of leaf surface, and generally dry and unhealthy gave poor results—and that a dead tree behaved practically as an insulator. In live trees the electromotive force of the tree will vary with change in the weather. In Squier's experiments a curve of volt-time variations of a large eucalyptus tree was obtained in the rough by using a standard milli-voltmeter. The resistance of the tree was about 6,150 ohms. The interesting feature of the record appears to be that the maximum changes occurred at times when the general influence of the sun during the day is withdrawn for the night (6:30 p. m. to 9 p. m.) and when this again appears in the morning (6:30 a. m. to 9 a. m.). The significant statement is made that resistances were more easily measured at night than in the day, as the balancing of the bridge was then more readily obtained.

Such changes might well be studied with the aid of self-recording multiple quadrant electrometers, and the fact established whether or not during the night hours there is a minimum of electrical activity in the atmosphere while during sunlight a rapid ionization goes on, resulting in a marked disturbance of the electrons and a consequent dissipation of electrical energy. Making use of this principle it might be possible to devise a sunshine recorder more sensitive than those now in use.

II. Behavior of Trees During Thunder Storms.

Particularly interesting and of great practical value is a knowledge of the behavior of trees under great electrical strain, as for example during thunder storms previous to the beginning of rain. The question has a practical significance if it be remembered that probably the majority of the lives lost annually not only in the United States, but throughout the world, by lightning, are those of persons standing under trees for shelter. The loss of stock and sheep is also largely through this same cause, although in certain parts of the United States the barbed wire fence is equally dangerous. Furthermore no inconsiderable number of forest fires are started by trees which have been struck by lightning.

Satisfactory explanations of the reason why some trees are apparently so much more liable to lightning stroke than other

FIG. 2.—EFFECT OF LIGHTNING ON A POPLAR TREE.

trees have not yet been given. The oak is especially liable to injury, and the beech only infrequently struck. The character of the root system is believed to be an important factor, more so probably than the nature of the wood or even the moisture content, though this last needs careful study. An important matter, as is shown in experiments noted below, is the condition of the tree. Living vegetable organisms behave differently from decaying, or dead vegetable fiber. A dead tree may be expected to act as a flag pole and it has been noted in the case of certain flag poles struck by lightning that the splintering effect was most pronounced at the top. In the living tree it would appear that the shattering or splintering effect is most pronounced in the trunk about midway between the ground and the foliage. There may be some connection between this and the fact that people are so infrequently struck when standing under trees.

Prof. Oliver J. Lodge once pointed out that with a wire joining the outer coats of two equally insulated Leyden jars, side flashes were strong at either end of the wire and not obtainable at the middle, the middle being in fact an anode. In the case of a tree there is a large collecting capacity in the foliage, connected with an infinite conductor, the ground, by a vertical resistance, the trunk of the tree, which is in fact a column of vegetable cells filled with conducting fluids. With electrical oscillations of high frequency the conductivity becomes a matter of the amount of surface area rather than of the volume, and it is likely, therefore, in the case of lightning that the oscillations are very rapid and the conducting layer is either the outer bark or the cambium. Dead vegetable matter, thoroughly dried, acts probably as an insulator. An account of the relative liability of different kinds of trees to lightning stroke is given in "Lightning and Electricity of the Air" by McAdie and Henry, *Bulletin No. 26*, U. S. Weather Bureau, pages 64 to 69. It has also been shown by Jonesco that fresh wood of trees rich in fatty materials is a poor conductor, while fresh wood rich in starchy material is a good conductor.

Some illustrations of the effect of lightning upon trees are given herewith. Two photographs, indicating the effect of lightning on a poplar and a chestnut, Figs. 2 and 3, made by Mr. E. B. Calvert, show characteristic splintering. The following extract from the *Bulletin* referred to above describes the effect of lightning upon an oak and a walnut:

"In general, the effect of lightning stroke on trees is to plow one or more furrows down the side, as shown in Fig. 4. The tree in this illustration is a black walnut a little over two feet in diameter, situated on the edge of a forest and about 100 paces from a barn, which together with a dwelling house, the latter surrounded by locust trees, stands on the knob of a slight eminence. The tree was struck in January, 1899. A much more

FIG. 3.—EFFECT OF LIGHTNING ON A CHESTNUT TREE.

destructive effect is shown in Fig. 5. The tree in this case is an oak 16 in. in diameter and about 50 ft. high. It was struck in the summer of 1898, and the photograph from which the illustration was made was taken in March, 1899. The trunk of the tree lies on the right side of the tree as it fell; it is not very clearly outlined in the photograph on account of the dead leaves that still cling to the branches. The remarkable feature in this case is the fact that there is not a single vestige of the effect of the lightning stroke on the prostrate trunk above the point of fracture or splintering. It would seem as if the entire force of

FIG. 4.—EFFECT OF LIGHTNING ON A WALNUT TREE.

the discharge was felt only at the point of fracture. The ground at the root of the tree was not disturbed, and save for a slight crack, the stump is intact at the surface of the ground. Another, and somewhat similar case of complete fracture of the trunk of a tree by lightning, was observed in the same neighborhood. In the latter case there was less splintering, probably owing to the toughness of the wood, red cedar and the stump showed no injury below the point of fracture. Unfortunately, the top of this tree had been cut up for fuel and carried away before we could examine it."

In a tree there are, proceeding inward from the outer edge, first the bark, then the cambium, the wood and the pith in the order named. The cambium is the portion which probably acts as a conducting layer. Cross sections of trees which have been struck by lightning should be obtained and studied.

While there are doubtless marked rises in potential at the top and bottom of a tree, due to electrical surging, it is necessary to consider as equally important the "ground" which the root of the tree makes. Experiments might be made with a view of determining whether a metallic conductor from branch to earth would protect the tree. Excellent telephonic "grounds" have been obtained by utilizing the root systems of trees. Squier states that in a wooded country, "a much better ground could be obtained by attaching the earth side of the instrument to an iron nail driven into the trunk of a tree or shrub than by the ordinary and more laborious method of burying a conducting plate, or by driving an iron spike into the earth itself . . . "

It is found that the conductivity of a healthy living tree is often so good that a ground may be had by simply touching a

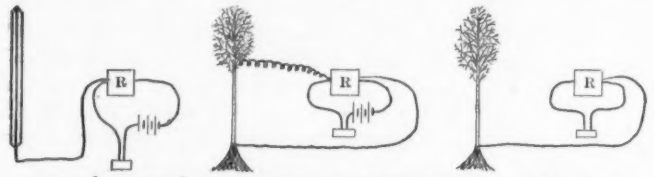
FIG. 5.—EFFECT OF LIGHTNING ON AN OAK TREE.

wire to an upper branch or twig. Experiments indicate that there are limitations to the use of trees as grounds. The root of a tree is a modified trunk. The cambium being practically continuous, an old root resembles a trunk in that it has concentric layers; the innermost of woody fibre is dead, and the outer layers or feeding roots alive and capable of absorbing moisture. Root systems differ for different trees, and it is more than likely that they play a determining part in the fracture of trees by lightning.

The line of strain from cloud to earth, consists of the charged surface of the cloud, one plate of the condenser, the intervening air column or dielectric, and the branch-trunk-root-earth system, or other plate of the condenser. When the electric strain exceeds the dielectric strength, the break-down, or fracture, occurs; the main line of fracture shown by the streak of incandescent air which we call a lightning flash and the minor ramifications are the branch discharges. Photographs show some of the more prominent of these minor breaks; but there must be a large number which pass without notice.

In some experiments made by the writer at the top of the Washington Monument and elsewhere, it was shown that the needle of a quadrant electrometer could be successfully used to indicate the degree of strain in the air during the passage of a thunder cloud. Moreover the equalization of potential caused

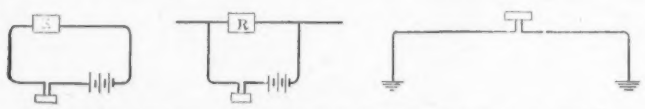
by every discharge could be detected, and it was discovered that numerous discharges which otherwise passed unnoticed could be thus detected. These experiments should be repeated and some measurements made of the relative frequency and intensity of the discharges of all natural condensers. It might also be practicable to study the differences of potential between the tops of trees and the roots; and to determine whether the trunk portion of a tree maintains the potential of the ground during a thunderstorm, or whether there are momentary marked differences of potential at points on the trunk system, and corresponding nodal points increasing liability to side flashes. The



FIGS. 6, 7 AND 8.—DIAGRAMS OF EXPERIMENTS 1, 2, 3 AND 4.

effect of lightning upon trees might also be studied by microscopic analysis of wood specimens.

Some interesting observations upon trees struck by lightning are given by K. E. F. Schmidt in *Elektrotechnische Zeitschrift* for September 7, 1905. The track of the discharge seemed to be along certain grooves, following the grain of the wood. By injecting staining fluid in the roots of some maples and oaks it appeared that this was carried slowly up the trunk in certain narrow paths. It was therefore argued that the electric discharge probably passes from the top branches to the roots along these paths. For wireless work one connection should be made at that

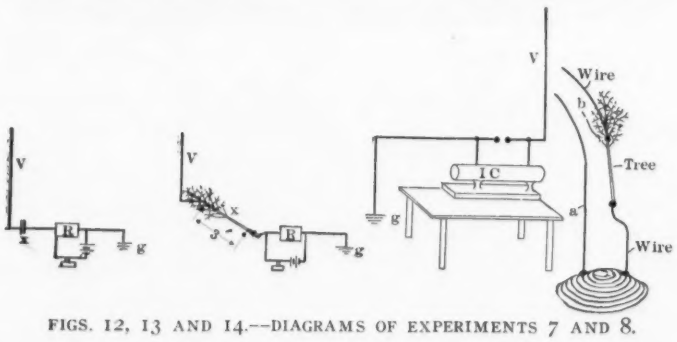


FIGS. 9, 10 AND 11.—DIAGRAMS OF EXPERIMENTS 4, 5 AND 6.

portion of the trunk where one of these lines of communication can be tapped, and the other connection with the branches corresponding.

III. A POSSIBLE COLLECTOR FOR ATMOSPHERIC ELECTRICITY.

In 1887 Rowland and Morrill devised a mechanical collector to take the place of the Thomson water-dropper in common use. The principal objections to the water dropper are the change in head, the varying character of the jet and the freezing of the water during winter months. The mechanical collector referred



FIGS. 12, 13 AND 14.—DIAGRAMS OF EXPERIMENTS 7 AND 8.

to above, which was described in the report of Prof. Mendenhall, consisted of a revolving arm driven by heavy clockwork, which arm alternately covered and uncovered the cap of an insulated conductor called the inductor. The arm was connected with earth. The inductor was alternately connected with the ground and to an electrometer. No definite results were obtained with this collector owing to causes beyond the control of the designers. There is no reason to think that a mechanical collector constructed on these lines would not be efficient. An improvement might be effected by the substitution of two rubber discs, carrying metallic sectors, the discs revolving in opposite directions. In place of water dropper, nitrate of lead, match or flame collector, a collector using mercury, might be employed, the drops falling between the faces of the discs and being caught in a proper receptacle and returned to the dropper mechanically. A constant pressure could easily be maintained. It might also be desirable for comparative studies to provide a chloride of radium receptacle on the collector.

IV. WIRELESS EXPERIMENTS WITH TREES.

Mr. W. W. Thomas, in charge of the Weather Bureau office at Mount Tamalpais, made the following experiments, bearing chiefly upon the conductivity of freshly cut trees. The apparatus used consisted of two aerials, each 20 ft. in length and composed of seven strands of No. 14 copper wire. The receiving set consisted of a portable outfit, comprising a wave detector and necessary adjuncts. The sending set consisted of the usual coil and aerial and a special device for making and breaking.

Experiments 1, 2, 3 *and* 4.

The object of the experiment indicated in Fig. 6 was to test the effectiveness of the apparatus. A portable receiver, *R*, was connected with the vertical, there being no ground connection. The signals could be plainly heard in the telephone.

The object of the experiment of Fig. 7 was to test Squier's statement that electromagnetic waves are received by a living tree. Receiver, *R*, was connected with a living bush having luxuriant foliage, 15 ft. high and 200 ft. from sending station. The signals were heard easily, thus confirming Squier's view.

The object of the experiment indicated in Fig. 8 was to eliminate the foliage and the trunk of the tree and test electromagnetic effects through the ground. The signals were heard, but less distinctly.

Experiments Nos. 4, 5 *and* 6.

The object of the experiment shown in Fig. 9 was the elimination of trunk and roots, and to test whether signals could be heard with the receiver insulated. Neither ground wire nor vertical was used. The signals were heard.

Fig. 10 shows the circuits used to test the capacity of two insulated wires, each 25 ft. in length, connected with the receiver only. The signals were heard distinctly from a distance of 600 ft.

Fig. 11 shows the circuits when two wires were connected with a telephone receiver and the loose ends earthed 30 ft. apart. No battery was used. The vertical was removed from the induction coil, but one terminal of the coil remained connected with the earth. The signals were heard distinctly. It is seen, therefore, that electromagnetic effects can be detected regardless of trees and roots, unless it be that the surrounding trees and root systems act as antennæ.

Experiment No. 7.

The receiving apparatus was set up as shown in Fig. 12, 600 ft. from the transmitting station, and the strength of the signals (which were clear and very distinct) were carefully noted.

The vertical was parted at *X*, and a thrifty, live bush, full of sap, and about 10 ft. in length, which had just been cut off at the roots, was introduced into the break, as shown in Fig. 13, at *B*; the bush thus became a part of the aerial; not the faintest signal could be heard. The arrangements were alternated a number of times with the result that signals were always heard with 12 and never heard with 13. The bush failed to conduct the oscillations. The effect is the same as introducing impedance.

Experiment No. 8.

The sending apparatus was set up near a large coil of cable (lead-covered). The spark-gap was set at about one-eighth inch. Two wires, *a* and *b* (Fig. 14), were attached to the sheathing of the cable and the loose ends placed conveniently near the vertical; *b* was parted and a live bush was introduced into the break. Upon touching the vertical with *a*, while the coil was in operation sparks ceased to cross the gap, but touching the vertical with *b* made no apparent reduction in the amount of spark crossing the gap.

Experiment No. 9.

The vertical was erected at a railroad track 300 ft. from the wireless station. A capacity was used as a ground for the receiver. An insulated wire, *O* (Fig. 15), was connected with

one of the rails of the track, and the loose end was placed conveniently near the receiver. An insulated wire, *M*, was connected 10 ft. above ground to a young tree 30 ft. in height, and the loose end of the wire placed near the receiver. Loud and clear signals were heard through the receiver without either *O* or *M* being connected with the receiver. Upon holding *O* against the vertical at *X* the signals disappeared at once. On removing *O* and connecting *M* with the vertical at *X* the signals reappeared as clearly and distinctly as at first; *O* and *M* were

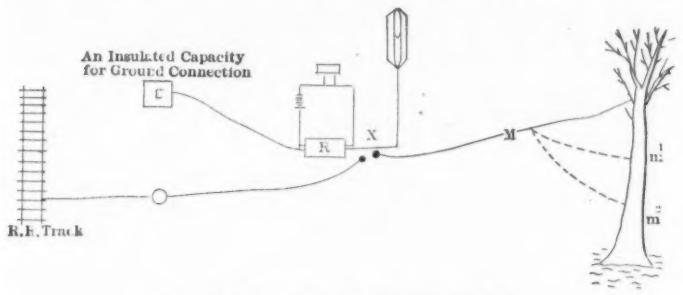


FIG. 15.—DIAGRAM OF EXPERIMENT 9.

alternately connected at *X* several times with the same results in each case, as first shown. The contact, *M*, was then moved down the tree and again alternated with *O* in connections with *V* at *X*, but with the same results. The wire, *O*, would readily conduct the electrical oscillations from the vertical to the ground at the rail, thus cutting out the receiver entirely, but the tree would not so conduct the oscillations from the vertical to the ground. Changing the position of *M* on the tree made no apparent difference in the results obtained.

Experiment No. 10.

While making experiment No. 10 it was found that a long insulated wire hanging over an embankment acted as a vertical; hence the arrangement in this experiment. The upper end of the wire, *M*, was connected to the receiver, and signals were heard distinctly. Connecting *M* to a small tree 30 ft. below made no apparent difference in the strength of the signals; *M* was connected further and further down the tree, but the results remain unchanged.

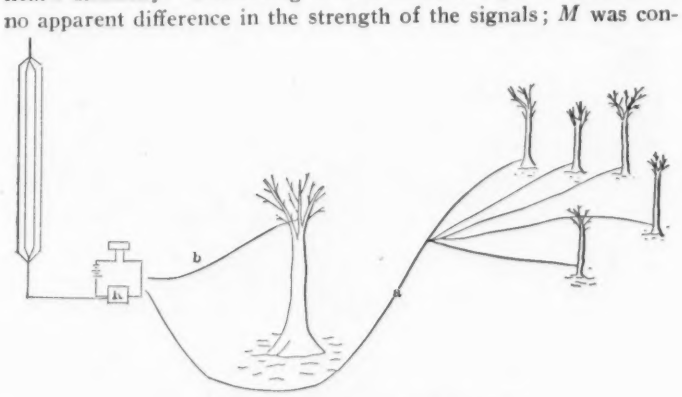


FIG. 20.—DIAGRAM OF EXPERIMENT 13.

Experiment No. 11.

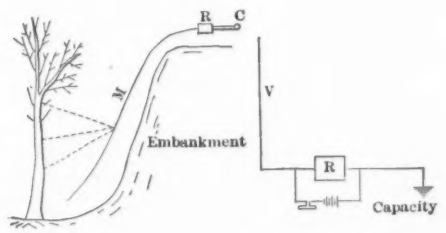
The receiving apparatus was arranged as shown in Fig. 17. The signals were loud and clear. The vertical was then released from the receiver and connected to a small tree at a point, *X*, three or four feet from the ground (Fig. 18), while the receiver was connected by a short wire to the same tree at a point, *Y*, about one foot from the ground. Not the faintest signal could be heard. The contact, *X*, was made closer and closer to *Y*, but still no signals were heard. When *X* and *Y* were finally brought in contact the signals reappeared with the same strength as when the vertical was connected as shown in Fig. 17. This is similar to the second part of Experiment 8, and proves that the tree trunk acts as an impedance. The same result would follow by the introduction of a choke coil. Squier notes that even 100 ohms will materially modify the signals.

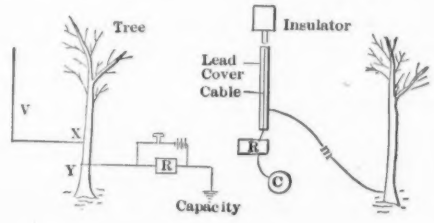
Experiment No. 12.

A section of nine conductor, lead-covered cable, 15 ft. long, was suspended in free air from an insulator, as in Fig. 19. The sheathing was ground by a wire, *m*, leading to the root of a tree. On connecting the cable wires to the vertical pole of the receiver, the signals were heard distinctly. The distance was about 600 ft.

Experiment No. 13.

The vertical used was 50 ft. long, and cage shaped. A primary ground wire of insulated copper wire with several branches was connected to green scrub oaks at the earth line, as indicated in Fig. 20. A secondary ground consisting of a single copper wire was connected to the top of a green scrub oak. Signals from the sending station, 400 yards distant, were plainly heard without any ground connection and receiving box insulated from earth. The signals were slightly increased on introducing a primary ground. When both the vertical and the primary ground were connected to the vertical post, the signals were greatly reduced, but were not entirely eliminated. The secondary ground wire had no effect whatever upon the strength of the signals.

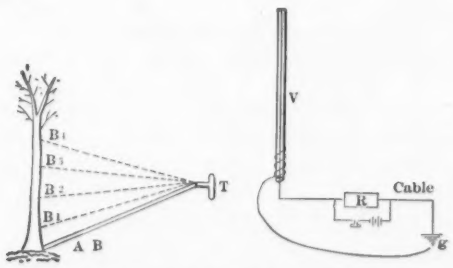




FIGS. 16, 17, 18 AND 19.—DIAGRAMS OF EXPERIMENTS 10, 11 AND 12.

Experiment No. 14.

The two wires of a head telephone, *A* and *B* (Fig. 21), were connected near each other at the base of a tree. No signal was heard. When *B* was moved higher, as shown at *B*1, *B*2, *B*3, the signals increased in strength until *B*4 was reached. When the terminals were left at *A* and *B*4 and the vertical was disconnected from the induction coil, signals were heard as before. When the vertical was replaced, and the ground wire of the coil was disconnected no signals were heard. The distance was about 50 ft.



FIGS. 21 AND 22.—DIAGRAMS OF EXPERIMENTS 14 AND 15.

Experiment No. 15.

For this experiment there was used a section of lead-covered cable (Fig. 22), 15 ft. in length, having its sheathing earthed, and its inner wire connected to *R*, and no electrical connection between the sheathing and the inner wire. A roll of wire netting having a fine mesh was wrapped around *R*, completely covering it, top, bottom and sides. The telephone wires were kept en-

tirely within the wire covering. Signals were heard, and they were scarcely less distinct than those heard when the netting was removed. The only openings in the wire covering were those just sufficient to admit the aerial and the ground wire. However, these openings, though small, were sufficient to admit enough radiations to distinctly affect the receiver.

The following apparatus was used in these experiments: Two aerials, each 20 ft. in length and composed of 7 strands of No. 14 copper wire. One of these aerials together with a portable receiving set constituted the receiving outfit, while the other aerial together with a small induction coil actuated by the current from four dry cells constituted the sending outfit. The maximum spark length used was one-fourth inch.

An automatic device for operating the sending apparatus during the absence of the writer in making the experiments was devised and put in operation. This consisted of a tipping water bucket arrangement actuating a mercury commutator. During part of the time occupied by the bucket in tipping from one position to another, a circuit was completed. A gallon of water was sufficient to operate the device for several hours.

The Boston Edison Company's Natick Station.

In the extension of its distributing system to the westward the Edison Electric Illuminating Company of Boston has found it necessary to establish sub-stations at important centers of population, in several cases replacing old steam plants by modern transforming and distributing equipment. The lines of this company now reach as far west as Holliston. a town about 25 miles from Boston. The main generating plant of the system at L Street, South Boston, supplies power to a large number of cities and towns outside the limits of Boston proper, and the Natick and South Framingham district is served through a 900-kw distributing station located in the town of Natick on the Saxonville branch of the Boston & Albany Railroad. Several features of this station are of interest in view of its replacement of the old belt-driven steam plant which formerly supplied the Natick territory with electricity.

The Natick station or "Station No. 23," as it is known on the Edison system, at present supplies current for lighting and power to the towns of Natick, South Framingham, Ashland, Cochituate, Holliston and to the sections known as Saxonville, Framingham Centre and also the street lighting of the town of Wellesley. All the power and light sold in this territory is supplied by 60-cycle alternating current. The current is generated at the L Street station in South Boston, transmitted to the Zeigler Street sub-station in Roxbury and thence to the Dedham sub-station, whence it is brought into Natick at a potential of 6,350 volts in three three-phase circuits. About half a mile of the Natick lines is placed underground, between the station and the town center.

In order to remodel the old power house it was necessary to tear out all the equipment which had formerly carried the load in the territory served, and to install an entirely new outfit in the renovated area. The old power plant consisted of a boiler room and an engine room with a low basement beneath the latter, the station being a brick structure with a tar and gravel roof. These two rooms were retained in laying out the new plant, the old brick stack being painted white and labeled "Edison Light" in striking letters for the benefit of passersby. An illuminated sign is also in use on the stack as noted elsewhere in this issue.

The sub-station is characterized by ample room and excellent natural light supply. The old boiler room is now occupied by an H. B. Smith No. 2 Mercer boiler for steam heating the building, special toilet and washing facilities for the employes and a linemen's storeroom, which is partitioned off with a screen from the rest of the room. The water for washing is electrically heated by a 40-gal. tank supplied by the Simplex Electric Heating Company, of Boston, the coil operating at 110 volts alternating. The basement is unoccupied, except by induction regulators connected in the outgoing lines.

The engine room of the old plant is now the transformer and switchboard room. It is 54 ft. long by 48 ft. wide, with a concrete floor and a roof supported by wooden trusses. It contains a row of high-tension switch cells, 900 kw in transformers, a distributing switchboard, storage battery charging set and four 50-light tub transformers with appropriate panels for arc lighting service. General views of the transformers and switchboard equip-

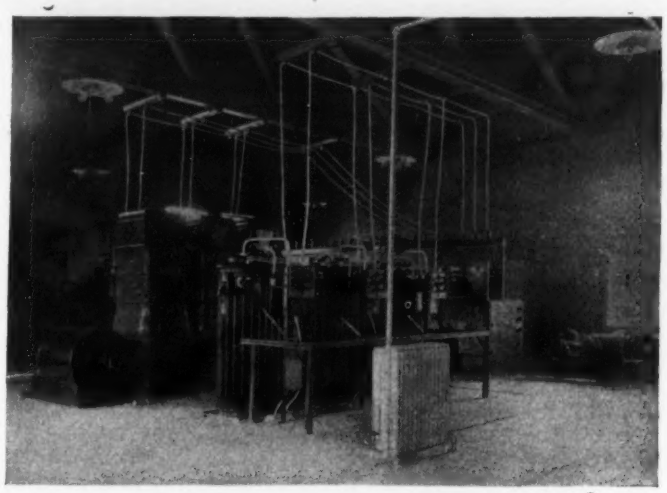


FIG. 1.—TRANSFORMER BANKS AND HIGH-TENSION CELLS.

ment, the former also showing the wiring to the transformers, are given herewith. Probably the most interesting feature of the sub-station is the great flexibility of its electric wiring, although another interesting point is found in the fact that there is not a revolving piece of machinery in the plant, with the exception of the battery charging motor-generator set and the transformer blowers.

The 6,350-volt current from Dedham enters the station in three circuits brought up through the floor behind the switch cells, in insulated lead-covered cables. After passing through end bells and current transformers the current is led to the switch cells. There are six of these cells occupying a space 20 ft. long and 3 ft. 8 in. wide, with a clear space of 3 ft. 1 in. between the cells and the wall. There are six double-throw, triple-pole automatic oil switches here, and two sets of three-phase bus-bars. Any

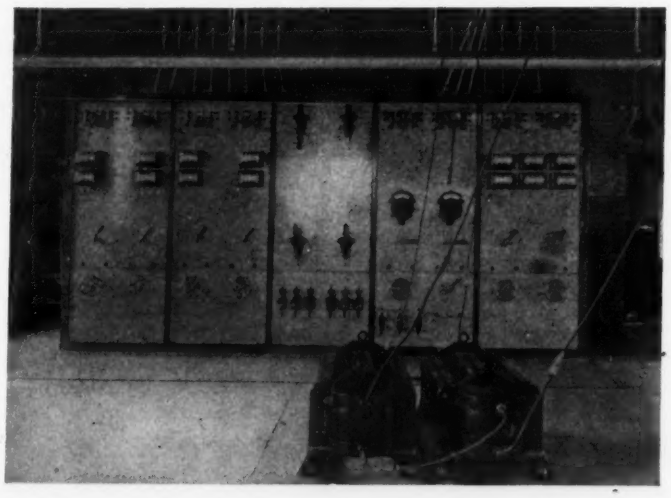


FIG. 2.—DISTRIBUTING SWITCHBOARD AND TEMPORARY TRANSFORMERS.

incoming set of lines can be thrown upon either set of buses. From the 6,350-volt buses are supplied the transformer banks, as shown in the diagram. There are two sets of stationary transformers and a group of tubs. The stationary transformers consist of three 200-kw air-blast units and three oil-cooled, 100-kw transformers, delta-connected in the primaries and star-connected with a neutral wire in the secondaries. The secondary voltage is 2,300.

The high-tension air-blast transformers are cooled by two 35-in. Buffalo Forge Company's blowers, each driven by a 2-hp, 220-volt, three-phase induction motor. Disconnecting oil switches

hand-operated are provided in the high-tension lines at the transformers and knife switches in the secondary leads. Recording and indicating wattmeters are installed with suitable transformers in the high-tension side of the station between the oil switches and the transformer primaries. All 6,350-volt lines are run overhead through the station in plain sight, and the wiring is painted white to render it conspicuous.

The battery-charging set consists of a 10-hp Wagner single-phase induction motor wound for 104 volts and direct-connected to a 57-amp., 115-volt Wagner generator running at 1,800 r.p.m. A charging panel is installed in connection with this set, which is used for electric automobile charging, which is rapidly becoming an important feature of the service.

The distributing switchboard consists of five blue Vermont marble panels upon which are mounted the various automatic oil switches and instruments controlling and measuring the outgoing leads. This board carries 2,300-volt service in two sets of four-wire, three-phase bus-bars. Either set of transformer secondaries can be thrown upon either set of buses, and any outgoing circuit can likewise be transferred from one bus group to the other. The auxiliary circuit for the release of oil switch trip coils is operated at 110 volts. Each outgoing circuit is equipped with an Elden circuit-breaker, potential and current

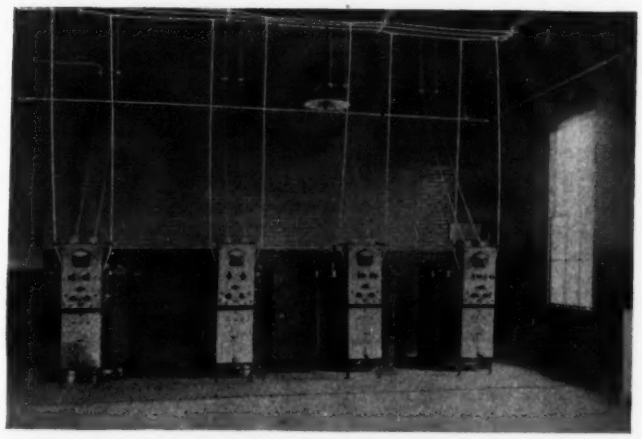


FIG. 3.—CONSTANT-CURRENT TRANSFORMERS.

transformers, induction regulator and recording wattmeter. The oil switch relays are connected so that if a heavy overload occurs upon any phase the other phases from that bus-bar set will be open-circuited. The distributing circuits are mainly single-phase lines, none smaller than No. 2 wire being used. The 2,300-volt buses are built up of 300,000-c.m. cable, and the distributing board is installed 7 ft. from the nearest parallel wall.

The tub transformers are supplied by a single set of three-phase bus No. 0 leads running overhead from the 6,350-volt oil switch compartment to the group of tubs. Totalizing wattmeters, indicating and recording, are connected between the oil switch compartments and the transformers, and one lead of each outgoing alternating-current arc circuit is equipped with a Palmer short-circuiting trip which prevents the building up of high potentials as the transformer coils come together, by opening the primary circuit at the moment the break occurs in the secondary.

The 6,350-volt buses are of No. 0000 section. The Wellesley street lighting circuit is entirely of the incandescent type at present, so this line is taken off the 2,300-volt distributing board; the two transformers shown on the floor in the cut being merely temporary. The circuit-breakers in the plant are all of the Condit type and all the rest of the electrical equipment was supplied by the General Electric Company. The lighting of the distributing switchboard is very effectively accomplished by a series of five 16-cp incandescent lamps set in a long horizontal reflector, shown in the illustration. The incandescent lamps are mounted on the switchboard itself. The transformer room is lighted by nine four-light clusters of 16-cp units, and the distributing switchboard is 16 ft. long and 7 ft. high. The middle panel is devoted to the transformer secondaries and the outgoing lines are controlled by the others.

The Diversion of Water from Niagara.

By Alton D. Adams.

Water diverted from the Great Lakes or Niagara River reduces by just so much the volume that goes over the Falls, but the relative effects on the two cataracts depend on the point at which the diversion takes place. The Chicago Drainage Canal which diverts Lake Michigan water to the Mississippi River, the Welland Canal which carries water from Lake Erie to Ontario, and the Erie Canal which allows water from the lake of that name to flow over the Niagara escarpment, all lower the river level along its entire length above the Falls. Such general reduction in the level of the upper river diminishes the volume of water at both the American and the Horseshoe Falls, but the effect on the former is much the more notable, because the bed of the channel on the New York side of Goat Island is as much as ten feet higher than that on the Canadian side. As a result of this difference of elevations in the two channels, and of the fact that the one above the American Falls is only one-eighth as wide as that on the Canadian side of Goat Island, it is estimated that as much as 90 per cent of the entire discharge of the river goes over the Horseshoe Falls. From all these facts the inference has been drawn that the diversion of certain quantities of water from the Great Lakes and the Niagara River, put by one authority at 80,000 cu. ft. per second, would lay bare the precipice over which the American cataract plunges. This opinion must be taken with some limitations. If 80,000 cu. ft. of water per second are diverted from Niagara River along the New York bank, within a mile above the head of Goat Island, there can be little doubt that the American Falls will be totally destroyed. A similar result, at times of low water, would probably follow the diversion of water at this rate from any part of Niagara River or the Great Lakes, above the head of Goat Island. But a large part of the present and prospective diversion of water from Niagara River takes place along the Canadian bank, at points 1,000 to 4,000 ft. above the crest of the Horseshoe Falls. Add to this the fact that the river descends fully 50 ft. on the Canadian side, and more than 40 ft. on the New York side of Goat Island, along a distance of 3,000 ft. above the crests of the Falls, and it is evident that the operation of the power plants in Queen Victoria Park must be largely at the expense of the greater of the two cataracts. Detailed examination of the intake works of the power plants makes this point clear.

Three large electric power plants now have intakes along the water front of Queen Victoria Park, and there is also the intake for the comparatively small plant of an electric railway. First or highest of these intakes is the one just above the Dufferin Islands, and opposite the upper end of Goat Island, fully 4,000 ft. from the crest of the Horseshoe Falls. This intake is 618 ft. long, and the water between its piers has a depth of 13 ft., when the low level of the river is 553 ft. above the sea. At times of high water the surface of the river at this intake is 560 to 561 ft. above sea level and the depth is about 20 ft. Some few feet downstream from the lower end of this intake, which runs out diagonally from the shore, comes the upper line of the series of cascades over which the water descends more than 50 ft. to the crest of Horseshoe Falls. Across and above the river from the intake, the natural water level is about that named above, and water drawn from the forebay fed by the intake will affect the level of the entire river above the head of Goat Island. While the greater part of the water diverted from the river at this point must come from the Canadian channel, it will no doubt diminish to some extent the flow over the American Falls. Three steel pipes will lead from this intake and forebay to the Gorge below the Falls, and of these pipes two have a diameter of 18 ft. each, and the third a diameter of 20 ft. No limit seems to be placed on the volume of water to be carried by these pipes, save that due to their diameters, friction and slope, which latter is 28 ft. in a length of 6,180 ft. At present it is understood that the plans call for the carriage by these pipes of about 14,000 cu. ft. of water per second,

but it is computed that only about 20 ft. of the head will be required to maintain this rate of discharge, so that the remaining 8 ft. of drop in these pipes may be utilized to obtain a larger flow. Besides the drop of 28 ft. along these 18 and 20-ft. pipes, there is an additional head of at least 19 ft. that may be used to increase their rate of discharge, as the centers of these pipes at the gate house that marks the lower end of the forebay is 19 ft. beneath the low water level there. Next in point of position, along the water front of Queen Victoria Park is an intake and forebay that begins at a point in the river about 2,200 ft. above the crest of Horseshoe Falls, and runs diagonally into the bank. Along the upper line of this intake, the low level of the river is about 533 ft. above sea level, and this is also the elevation of the great gathering dam, with a bull-nose at its upper end, that runs up and out from the shore of Queen Victoria Park, until it reaches a point 600 ft. from the old line of the bank. From the bull-nose of this gathering dam to the lower end of the intake above the Dufferin Islands, as before described, is about 1,100 ft., and in this distance the river drops some 20 ft., or from elevation 553 to 533, at low water, over two lines of cascades. The first or highest of these two cascades crosses the Canadian channel from Queen Victoria Park to a point on the shore of Goat Island about 300 ft. below its head, and a little above the Three Sister and Little Brother islands. About 400 ft. downstream from this first or upper cascade, the Canadian channel is crossed by another, that lays some distance above the intake under consideration, and reaches Goat Island below the Three Sisters. As the division of Niagara water between the American and the Canadian channel is definitely made at the head of Goat Island, it seems that after the Canadian portion has reached a point some 1,700 ft. below the upper end of that island, and has fallen 20 ft. over two lines of cascades, its diversion into the pit and tunnels of a power plant can have little or no effect on the volume of the American Falls. By means of this second intake it is proposed ultimately to divert some 22,000 cu. ft. of water per second from the river, but the power house now under construction has a capacity for only one-half of this amount. Substantially all of the water taken by this plant will diminish the Horseshoe rather than the American Falls. The third and lowest of the intakes of the great power plants in Queen Victoria Park is located on the shore, about 1,000 ft. in a direct line from the crest of the Horseshoe, and some 3,000 ft. downstream from the first cascade. Along the line of this intake the low water level is 514 ft., or 39 ft. below the surface of the river before it reaches the first row of breakers, after passing the head of Goat Island. It having fallen 39 ft. since the division at the head of Goat Island was made, the diversion of water at this intake can have material effect on the volume of the American Falls. Horseshoe Falls will thus furnish the entire volume of water for the power plant connected with this intake, which will divert about 9,000 cu. ft. per second. One other power plant, devoted to the operation of an electric railway, has an intake on the shore of Queen Victoria Park, some 450 ft. from the crest of the Horseshoe, but the volume diverted at this intake appears to be materially less than 1,000 cu, ft. per second.

From this review of the hydraulic developments for the power plants along the water front of the park, it is evident that only one of them is capable of lowering the surface level of Niagara River above Goat Island, and thus diverting water from the American Falls. This one plant is to have power machinery that requires 14,000 cu. ft. of water per second, according to the plans now announced, but its three pipes may be used to divert a much larger quantity from the river, at a point above the first line of cascades. As this diversion takes place near the Canadian bank, its effect will be greater on the Horseshoe than on the American Falls, but it will no doubt take some water from the latter. For the three large and one small plant along the water front of Queen Victoria Park, the total contemplated diversions of water, as above named, amount to some 46,000 cu. ft. per second. According to the figures of the United States War Department, the discharge of Niagara River, at the low Lake Erie level of 570.25 ft. above the sea, which is not, however, the lowest level of that lake, is 165,340 cu. ft. per second. If the Canadian channel gets 90 per cent of this discharge, the proportions assigned to it by the most favorable estimates, it carries 148,800 cu. ft. of water per second, when Lake Erie has the above level. Deducting from this last named volume the 46,000 cu. ft. per second found for all the power plants on the water front of Queen Victoria Park leaves 102,000 cu. ft. per second to go over the Horseshoe Falls. This figure should be a little more than 102,000, because a small part of the 46,000 cu. ft. will come from the New York side of the river, due to the diversion near the Dufferin Islands and above the first cascades. An imposing volume thus appears to remain for the Horseshoe Falls, as far as the Canadian plants are concerned, but when the discharge of 165,340 cu. ft. per second was noted there was no diversion at Chicago, and only a small one on the New York side of Niagara Falls.

Under present conditions, with the lake level of 570.25 ft. above the sea, 165,340 cu. ft. of water per second would never reach the head of Goat Island, and so the Canadian channel would get something less than 148,800 cu. ft., from which to supply the 46,000 cu. ft. per second for the power plants in Queen Victoria Park. The result would be a discharge of less than 102,000 cu. ft. per second over the Horseshoe Falls.

In any event, those who are more interested in the preservation of the American Falls may find comfort in the fact that only a small fraction of the water diverted in Queen Victoria Park could have found its way to the lesser cataract.

The Development of the Westinghouse Company's Single-Phase Railway System.

That the single-phase railway system is now definitely established as an important factor in the railway field, and that it is certain to play an increasingly greater part in electric traction, appears no longer to admit of dispute. The rapidity of the recent development of this system is made evident in the description recently printed in these columns of the New Haven locomotives with their great gearless single-phase motors; and we believe it will be a matter of interest at this juncture to retrace from the first beginnings the various stages of the Westinghouse Company's system up to the present development, as illustrated by the New Haven motors. On a recent visit to the Westinghouse Works data were gathered for such an account, which is presented below.

Early in the year 1893 the problem connected with the use of single-phase current for traction was investigated, and on April 29, of that year, design specifications were prepared by Mr. B. G. Lamme for a single-phase railway motor. This machine was designed for 16⅔ cycles and for an output of 30 hp at 200 volts. It was provided with a laminated field core having 12 poles, without slots or compensating winding. The armature was of the commutator type without auxiliary resistance in the leads. This motor was completed and thoroughly tested, its operation being fairly satisfactory.

On September 9, 1897, specifications were prepared by Mr. Lamme for a 40-hp, 60-cycle, 200-volt, single-phase series motor. Two of these machines were completed. They were of the inductively-compensated type, and were used with narrow brushes. These motors were in commercial service for eight or nine months, after which they were replaced by constant-speed motors, not so much owing to the better performance of the latter machines as to the fact that the service did not require variable-speed motors.

In the year 1900 the single-phase railway problem was again attacked, this time with a view to reaching a final solution. For the purpose of making exhaustive tests on a scale comparable to actual railway conditions, design specifications were completed on May 20, 1902, for a 100-hp motor which was operated with very gratifying results at a frequency of 16⅔ cycles per second. The armature of this machine was provided with auxiliary leads placed away from the armature core in the space between the core and the commutator. The auxiliary leads were given a resistance such that the decrease

in the loss due to the short-circuit current was much more than the increase in loss caused by the introduction of the resistance in the path of the main line current, so that the total loss was less with the leads than without them. On account of this action, combined with the spark-preventing features of the leads, the term "preventive" has been applied to the auxiliary leads. The armature winding was later altered so that the preventive leads were placed in the bottom of the main core slots. The field core was constructed with projecting poles in which holes were cut transversely to the direction of armature rotation in order to aid in reducing the cross magnetization and in decreasing the armature reactance. This construction was described in detail in two United States patents issued May 3, 1904, to Mr. Lamme on application filed December 26, 1901. (See Electrical World and Engineer, May 14, 1904. A British patent describing the same motor was reviewed in our issue for February 13, 1904.)

It was on the strength of the tests made with the motor just mentioned that the Westinghouse Company accepted the contract to supply single-phase equipment for the Washington, Baltimore & Annapolis Railway. The design specifications for the motor for this system, which were prepared on Aug. 26, 1902, called for an 8-pole, 100-hp machine to be operated at 700 r.p.m. by 16⅔-cycle current at 200 volts. The projecting field poles were slotted and in the slots was placed a so-called "compensating" winding. The preventive leads were arranged in the main slots immediately under the armature winding. This railway system was outlined by Mr. Lamme in a paper before the American Institute of Electrical Engineers, which was published in our issue for October 4, 1902. Although twelve of these motors were completed and tested in the shop with satisfactory results, they were never placed in commercial service, due solely to the financial failure of the companies interested in the W., B. & A. Railway.

In order to determine experimentally the factors which limit the capacity of the single-phase motor, it was decided in 1902 to construct a 300-hp machine for testing purposes, and design specifications were completed on July 16 of that year. This motor was provided with eight poles, and operated at 600 r.p.m. under an impressed e.m.f. of 400 volts. The projecting field poles were slotted; when 16⅔-cycle current was used with the machine, no winding was placed in the slots, but for 25-cycle current it was found desirable to use a compensating field winding in order to improve the power factor. Two armatures were built for the motor. In one of these the preventive leads connected between the armature winding and the commutators were placed outside of the armature core, while in the other the leads were placed in the same slots with the armature coils.

Owing to the desirability of using the same frequency for the single-phase railways as that in common use for motor purposes, and to the excellent results obtained with the compensated motors at this frequency, it was decided to build the standard single-phase motors for 25 cycles. On December 18, 1903, specifications were completed for a 150-hp, six-pole, 250-volt motor to operate at 700 r.p.m., with 25-cycle current. The preventive leads used with this machine were placed in the main armature slots. The field was provided with a compensating-winding connected permanently in series with the armature. This motor, which was the forerunner of the present standard single-phase machines, was sent to Sweden, where it is now in use. The standard motors have been built according to specifications prepared as follows: 100-hp, four-pole, 225-v., on December 18, 1903; 75-hp, four-pole, 250-v., on January 5, 1904; 50-hp, four-pole, 250-v., January 7, 1904. In these motors was introduced the present construction in which the compensating winding is placed first in slots in the projecting field poles, in order that the field coils, which are afterwards placed around the projecting poles, can be removed at any time without disturbing the compensating coils.

In regard to the methods used for controlling the motors, it is interesting to note that with the first 100-hp motor built for testing purposes there was employed a simple drum controller which varied the voltage obtained from the taps on a transformer winding. On the Washington, Baltimore & Annapolis Railway it was the intention to use an induction regulator for varying the voltage. On the present standard equipments, the induction regulator has been abandoned, and the step-by-step method of control is used. Several factors have contributed to this change. An induction regulator possesses fewer advantages at 25 cycles than it does at 16⅔ cycles; the step-by-step control is much preferable for equipments which must at times use direct current, and it lends itself most readily to electropneumatic unit-switch operation. Moreover, some form of multiple-unit control is necessary with many types of equipment, and the electropneumatic unit-switch system affords at once, and without change, convenient means of control from any desired point to which low-voltage wires may be led.

The cause for the change from 16⅔ cycles to 25 cycles was given above. It may be noted in this connection that it is more difficult to design a motor for 25 than for 16⅔ cycles, and that any satisfactory 25-cycle motor can be operated with 16⅔-cycle current. The designers hold that for services where the choice of frequency is not limited by reason of existing installations, that is, for the locomotives under steam railway conditions, it is preferable to use the lower frequency so as to simplify the design problem and to improve the performance of the equipment. During the period required for the introduction of the single-phase system, it is more or less necessary to consider the interconnecting of the new system with the old, and a frequency of 25 cycles is practically demanded for certain installations. There are, however, reasons for believing that the time will arrive when single-phase railways will be electrically separated from other power equipments, in which event a lower frequency can be selected.

Speed Control of Hydraulic Turbines.

At a meeting of the Philadelphia branch of the American Institute of Electrical Engineers, Mr. Lamar Lyndon presented a paper describing an electromagnetic method of regulating the speed of water wheels. The method is based primarily on changing rapidly the main gate opening of the wheel without altering either the pressure in the penstock or the velocity of the flow of water through the gate opening at the instant of change.

The control mechanism is so arranged that the velocity of the water in the penstock changes so slowly that there is never any appreciable fluctuation in the penstock pressure, or in the velocity of the entering water. There is applied to the penstock a compensating valve by means of which the pressure in the penstock is maintained. The compensating valve is of the butterfly type working in a by-pass pipe, which is tapped into the penstock.

All water which passes through the valve goes around the wheel and does no work. In plants where no waste can be allowed the valve is normally fully closed. If the turbine gate be quickly closed, the compensating valve will open quickly, thus acting as a positively operated relief valve. The valve then slowly closes tight, thus limiting the waste water to the ordinary relief valve losses.

In plants where the amount of water available is in excess of that passed through the turbine, the compensating valve is kept just half way open and a continual flow through it results. If the load on the turbine be increased, and the turbine gate be suddenly opened, the compensating valve will close, at the same speed, and thereby turn an increased amount of water into the turbine. If the load should decrease, the valve would open at once and allow more water to pass through it. In each case, when the regulation is completed for the new load, the compensating valve returns slowly to its normal half open position, thereby slowly changing the velocity of the water column to correspond to the supply required.

The active control mechanism consists of three electromagnetic clutches; one is used for opening the main turbine gate, the second tends to close the gate, while the third varies the opening of the compensating valve. When the gate openings are

correct for the load on the machine, none of the clutches is energized. If the load increases or decreases, either the first or the second clutch comes into play, while the third operates to tend to close or open the compensating valve.

A diagram of the control circuits is shown in the accompanying illustration. Both the first and second clutches and a dynamo for supplying current to all of the clutches are driven from the turbine. The dynamo is a simple shunt-wound machine. It is provided with laminated field cores, so that the magnetism may respond quickly to changes in the magnetizing force, and is operated at low magnetic density, in order that the voltage may vary enormously with a change in the speed. The speed at which the dynamo must be driven in order to generate a certain e.m.f. varies largely with the resistance in the field circuit, and this fact is utilized in adjusting the normal speed of the generator, and in giving to the turbine any desired load-speed characteristic.

The dynamo supplies current continuously to an electromagnet which serves to hold open the switches in the circuits to the three electromagnetic clutches when it possesses the proper strength, but allows the switch to the gate opening clutch to be closed by a spring if its strength is too small, and causes the

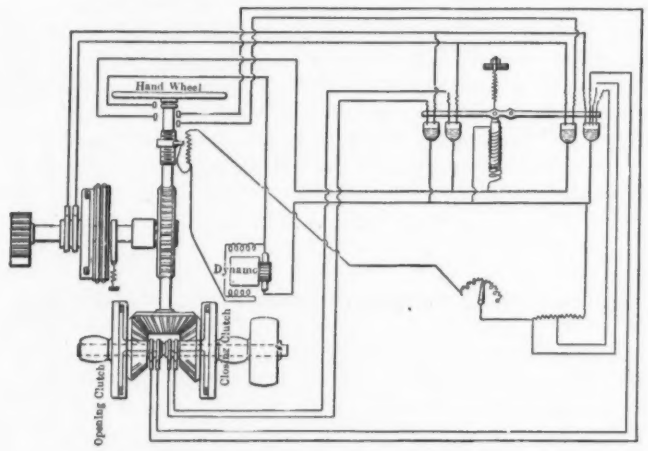


DIAGRAM OF CONTROL CIRCUITS.

switch to the closing clutch to be closed if its strength is too great.

The compensating valve is moved positively in a direction corresponding to the movement of the turbine gate by means of an electromagnetic clutch which is driven directly by the gate mechanism when either of the gate controlling electromagnets are energized, and is slowly returned to its normal position by means of a spring when the speed becomes normal and these clutches are idle.

New Telephone Patents.

COMBINED ALARM AND TELEPHONE SYSTEM.

While electrical power interests have been working constantly to level up the plant load by all sorts of means, telephone men have apparently given little thought to bringing up the economic efficiency of their wire plant. Few stop to consider that in the actual working day of the large majority of telephone lines, the actual total length of conversation per day is measured by minutes, instead of hours. As the lines represent an investment which must continually pay interest and depreciation, every effort should be made to increase the line efficiency, provided always there is brought about no interference with the telephone, for which the line is primarily designed.

A step in the right direction is described in a patent for a combined telephone watchman's clock and fire alarm system, issued to J. J. Berry, of Indianapolis. In this system the exchange may, at the end of the business day, cut off the telephone devices and cut in the watchman's recorder. This recorder receives the calls from the various premises, the record sheet progressing continuously. If the watchman fails to report within a given interval after the expired time for any signal, an alarm signal is sent to the exchange. If the operator fails to locate the watchman by telephone a messenger may be sent. Mr. Berry's patent has been assigned to the Indianapolis Watchman Clock Company.

SWITCHBOARD CIRCUIT SYSTEMS.

In Fig. 1 is shown a transfer trunk signal system circuit of great simplicity. The relay being differently connected, responds to any difference of condition of the circuits of its two windings. The contacts of this relay further control lamp signals at either end of the transfer. Thus upon connection, the light at the calling end acts as an indicating signal, and that at the receiving end acts as a call signal. Upon disconnection, on the other hand, the signal at the calling end acts as an indicator while that at the other end acts to disconnect. The disadvantage at once evident is the confusion of call and indicating signals liable to arise in cases of two connections following each other closely. The circuit is the invention of C. A. Simpson, of Chicago, who has assigned his patent to the Kellogg Switchboard and Supply Company.

Another transfer circuit, invented by H. D. Stroud, of Chicago, has been patented recently, the patent being assigned to the Stromberg-Carlson Company. This also works through the use of differential magnets, these being wound on magnetic signals and located at either end of the transfer. In this case the coils are differentially connected into the two sides of the talking circuit. The signals are controlled by a plug-seat and relay combined in one apparatus.

H. G. Webster and W. M. Davis, both of Chicago, have

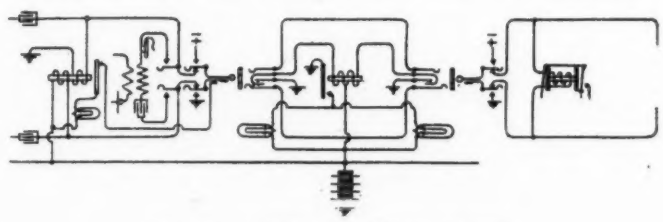


FIG. 1.—SIMPSON TRANSFER CIRCUIT.

obtained patents on two-wire switchboard circuits. The system of the former hinges upon a peculiar method of controlling the supervisory lamp. The circuit of these is formed partly by the talking wires, an impedance coil in series serving to effect non-interference. A single back contact relay controls the lamp circuit. The Stromberg-Carlson Company has been assigned the patent.

Mr. Davis's system of operating supervisory lamps is similar, but no impedance coil is included. The Stromberg-Carlson Company has been assigned this patent also.

NEW TRANSMITTERS.

E. E. Yaxley has patented a transmitter, the button of which is shown in Fig 2. The novelty lies in mica diaphragms which

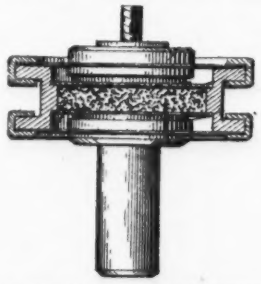


FIG. 2.—YAXLEY TRANSMITTER.

are perforated and are clamped in planes parallel to the faces of the electrodes upon which their edges bear. By this means the carbon granules are kept in contact with the electrode faces only. The electrodes are, of course, supported by the usual circular mica diaphragms in addition to the shielding diaphragms. The Honash Telephone Manufacturing Company has been assigned the patent for this transmitter.

Letters to the Editors.

A. I. E. E. Election.

To the Editors of Electrical World:

Sirs:—I have read, in your issue of April 21, Mr. Ralph D. Mershon's letter concerning the A. I. E. E. presidency, and also the letter from Mr. Rice, in reply.

I deem it a duty, as one of the members of the A. I. E. E. who not only has *had,* but has *taken,* opportunities to keep in touch with Institute men and Institute affairs—having attended over eighty per cent of all of the Institute gatherings, since 1884, the year of its birth, to express my cordial approval and indorsement of Mr. Mershon's views and position.

Mr. Rice's reply also compels me to add a few words of comment on his views and position and on the propriety and fitness of his candidacy for the Institute presidency.

Let it be clearly and emphatically understood, at the outset, that I hold Mr. Rice in the highest esteem, personally, and that my remarks relate merely to the propriety and fitness of his *candidacy.*

It is not surprising that Mr. Rice should promise to take active interest in the A. I. E. E., if elected. It may safely be asserted that if this were the only necessary and the sufficient qualification, there are several *hundred* members who also possess it. It could also be assumed with perfect confidence that any member who is a candidate would be apt to feel that way, especially about this time of the year. There may not be a total lack of interest on the part of Mr. Rice, but his interest does not appear to be sufficiently great to have induced him to sacrifice time or convenience to any remarkable extent.

Without entering further into the discussion of Mr. Rice's intentions, past and present, with respect to the Institute, and with due deference to the high personal merit of Mr. Rice, I wish to submit that the real question is not, after all, what is *due to Mr. Rice,* but really what is *due to the Institute.*

Mr. Rice, whether by his own wish or that of his friends, has become a candidate for an honor—a "degree"—perhaps the highest "degree" that can be conferred upon any member of the profession of electrical engineering, in this country. *If it is not the highest degree, it ought to be.* Now, as we all know, there are two kinds of degrees—*honorary* degrees and *earned* degrees. We all know that *honorary* degrees are granted in recognition of work, attainments, and prominence, *outside* of the Institution which confers the honorary degree. We also know that an *earned* degree is conferred, by a self-respecting, high-class Institution, only after a certain amount of work done *in that Institution,* independently and irrespective of whatever may have been done *out of it.* Any institution conferring an earned degree on the strength of a mere promise on the part of a candidate to take interest in the Institution and in its work, would, I need not say, cheapen itself and its degrees to the lowest value. If Mr. Rice's friends wish to have him honored, on account of the prominence of his *position,* or even of the technical work which he has done, *outside* of the Institute, then it should be done in the *regular* way. The Institute has provision for such cases, in its honorary membership. Let us make Mr. Rice an honorary member, and put him in the same class with Lord Kelvin and Sir William Preece, our two present honorary members. This ought to be a high enough honor for anybody. But, in my opinion, we owe it to the dignity and standing of the Institute that the highest degree which it can confer should be conferred for work done *inside* as well as *outside* of it. There are plenty of good men who satisfy both of these important, and, in my opinion, indispensable requirements; and Dr. Sheldon is preeminently one of these men. It is lowering to the dignity of the Institute and unjust to the many worthy men who have worked hard in and for the Institute, and who have, besides, all the qualifications of Mr. Rice for the office of president, that the principle which the candidacy of Mr. Rice represents, should be countenanced by the Institute. I feel this way, not at all because it is Mr. Rice, but because I deprecate the establishment of the precedent that "position" and "influence" *outside* of the Institute are of greater avail and value than meritorious work and prominence *inside* of the Institute. I feel that if influence wins the battle against merit, the presidency will have lost greatly in its value as an honor, and the Institute will have lost still more in its prestige.

I sincerely hope that the Institute membership will show, by electing Dr. Sheldon, that the honor of the A. I. E. E. presidency and the requirements for it are much higher than the estimate made of them by the friends of Mr. Rice.

As to your own editorial comment on the letters of Mr. Mershon and of Mr. Rice, it is a reflection on the intelligence of the A. I. E. E. members and associates, by the clear inference which it conveys, that they cannot distinguish between a "perfunctory" and a meritorious contribution to the *Transactions,* or that they do not know the difference between real, genuine service and merit, and the *spurious* merit based upon what you term "enforced activity in routine society work."

The reference to the question of residence, in your concluding paragraph, is a most unfortunate one, for Mr. Rice, in this case, because every member and associate knows that Dr. Steinmetz, who lives in the same place as Mr. Rice, has not found his residence to be a handicap sufficient to prevent him from becoming at least as great *inside* of the Institute as he is *outside* of it. The contrast between the "Institute records," in these two cases, cannot be anything but painful to Mr. Rice and his friends.

New York. C. O. Mailloux.

[Our comments last week on the letter of Mr. Mershon apply equally and with even more force to the above communication. The criterion proposed, if established, would exclude from the presidency such members of the Institute as Brush, Edison, Weston and others who have been the largest factors in creating the branch of engineering upon which the Institute is founded, and would practically confine the honor to a small coterie living in New York and vicinity. As to the relative professional qualifications of Prof. Sheldon and Mr. Rice, this we believe is a matter that should be left to the individual judgment of the membership at large.—Eds.]

Motor-Generator Fly-Wheels.

To the Editors of Electrical World:

Sirs:—I was much interested in the article in your issue of March 3 entitled "Ward Leonard System in a German Colliery." I find that the system described is rapidly going into extensive use abroad for heavy duties for hoisting, rolling mills, etc., etc., but it is generally spoken of as the "Ilgner System."

The only feature which might be attributed to Mr. Ilgner is the employment of a heavy fly-wheel on the motor-generator. In this connection I wish to point out that the advantages of such a fly-wheel were fully appreciated by me in 1891, and were demonstrated in an elaborate test at the works in Philadelphia of Wm. Sellers & Co. in the fall of 1891, a full description of which forms part of the record in my recent multiple-voltage patent suit. I urged the employment of such a fly-wheel frequently upon my licensees and others, and finally became so impressed with the advantages of a fly-wheel on a motor-generator that on March 27, 1896, I filed in the Patent Office an application (No. 585,038) showing a number of modifications of the idea, the principal application, however, being to heavy hoisting duty, using the Ward Leonard system. To quote from the application:

"The object of my invention is to provide a method and apparatus for storing energy outside of the source of supply and the translating devices, which stored energy will be drawn upon when a large amount of energy is suddenly required by the translating devices, so that the amount of energy drawn from the source is very much reduced. . . . My invention consists mainly in providing in the immediate vicinity of the translating devices a fly-wheel or its equivalent, which is continually in operation and whose weight and velocity represent a large amount of energy. . . . In the drawings, for simplicity, I have illus-

trated the motor-generator, *A B*, as two distinct armatures, with a fly-wheel between them. My invention, however, is not intended to be limited to the particular type of electrical apparatus described, nor to the use made of the fluctuating energy required in the translating devices, and my invention is applicable to both continuous and alternating systems, and to cases in which the final fluctuating current is used for translating devices other than motors, but applies broadly to instances in which electric energy fluctuating in character is demanded."

It will be noted that this application contains every published feature of the so-called "Ilgner System." In the Patent Office, however, I was met with the argument that I was only using a fly-wheel for its well-known purposes, and although I amended three times, all claims were finally rejected as devoid of patentable novelty, and as my patent lawyers thought it had no commercial importance I was persuaded to allow the case to die, which it did on March 8, 1901.

Bronxville, N. Y. H. Ward Leonard.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Changes of Energy in Dynamos.—Pichelmeyer.—A paper in which the author discusses in an interesting manner the changes in the energy of dynamos on the basis of Maxwell's theory and of the electron theory. As a striking analogy, he compares the induction phenomena in a direct-current motor running at no load with the rotation of a spinning top.—*Elek. und Masch.*, February 25.

Unipolar Single-Phase Motors.—Huppers.—A translation with illustrations of the German article on unipolar machines as single-phase motors, which was recently noticed in the Digest.—Lond. *Elec. Rev.*, March 23.

Compound Dynamos in Parallel.—An article illustrated by diagrams on the regulation of compound-wound dynamos operating in parallel.—*Power*, April.

Lamps and Lighting.

Tungsten Lamp.—"It is reported from Vienna that the German patents for the Wolfram lamp have been sold to financiers at Augsburg for the sum of $200,000, of which one-half is payable in cash, and the other half in shares of a new company which is to be formed with a paid-up share capital of $212,500 for the development of the invention in Germany. The manufacture of the lamp has been entrusted to the Augsburg-Lechhausen Glühlampen Fabrik, of George Lüdecke & Co." The lamp is the invention of Franz Hanaman and Alex. Tust, of Vienna.—Lond. *Elec. Rev.*, March 30 and April 6.

Photometry.—Satori.—A paper read before the Elec. Soc'y of Vienna. There is no difficulty in making photometric tests if lights of the same spectroscopic composition are compared. In comparisons of lights of different colors very great differences are often obtained if different persons make the comparisons. The author discusses at length the physiological reasons of this phenomena. It is essentially impossible to state whether two lights of different colors have the same brightness. The author discusses all physiological possibilities which have been tried so far for the comparison of lights of different colors, and concludes that it is impossible to compare the degree of the physiological effect of differently colored sources of light, for the reason that these physiological effects are of different nature.—*Elek. und Masch.*, March 18.

Photometry of Incandescent Lamps.—Lux.—In a method described in the regulations of the German Association of Electrical Engineers, incandescent lamps are tested by means of inclined mirrors, without revolving the lamp itself. However, the employment of this method is recommended only for lamps with a single-loop filament. The author shows that with filaments of several loops or with filaments of complicated structure (as in the tantalum lamp) this method leads to appreciable errors. In such cases it is necessary to revolve the lamp.—*Zeit. f. Beleucht.*, March 30.

Power.

Power House Economies.—Hancock.—A discussion of the importance of details of operation in power houses. The author first discusses the buying of fuel, and says that the only true way for the consumer to buy coal is on the heat-value basis. It should be agreed that the consumer will pay a stated price for the coal, provided it contains a stated value in heat units per pound of dry coal when unloaded at the power house, the values to be determined by analysis. For anything less than the stated heat value per pound a pro rata reduction in price is to be made to the purchaser, or the purchaser may reject it altogether. For any additional heat value, over and above the stated value a pro rata addition is to be made per ton. Proper attention should be paid to repairs in the boiler room and to the use of the proper kind of oil. If attention is paid to such apparently small details, considerable economies will result in the operation of power houses.—*Cassier's Mag.*, April.

Pyrometer Records.—An editorial advocating the use of the electric pyrometer as a power plant auxiliary. Probably the portable pyrometer is the simplest apparatus for general power-plant service. If desired, recording pyrometers can be installed in the flues, economizer and superheated steam mains, and connected to a common record tablet at any part of the plant where it is desired to take readings. The analyses of such records ought to throw a great deal of light upon the efficiency of combustion, the fitness of mechanical stokers for the work in hand, the value of various methods of hand firing, the steaming power of different fuels, the quality of chimney draft, etc.—*St. R'y Jour.*, April 14.

Water Power in France.—Bresson.—A statistical article on hydro-electric installations deriving energy from navigable rivers. In contradistinction to hydro-electric developments of waterfalls, the height of the fall of navigable rivers is small, but the quantity of water is large. The curve showing the water available during the different months of the year has a maximum in February and a minimum in July. On the other hand the corresponding curve for water power stations at waterfalls in the mountains has a maximum in July and a minimum in January. A list of French water power stations of the former type is given together with a map.—*L'Ind. Elec.*, March 25.

Italy.—A paper giving a statistical summary on the large water power installations of upper Italy.—Lond. *Elec. Eng.*, March 30.

Electric Driving of Machines.—Ker.—A paper read before the (Brit.) Inst. of Engineers and Ship Builders giving "notes on some common errors in the use of electric motors for machine driving." Direct-current motors are discussed and the adaptability of the series, shunt or compound motor is dealt with according to the requirements of speed and torque. The effect of fly-wheels in then taken up. The article is to be continued.—Lond. *Elec. Eng.*, March 30.

Electric Winding in Mines.—An account of the long discussion which followed the recent papers of Mountain and Hooghwinkel. Various speakers criticised Mountain's figures as being particularly unfavorable to electric winding. Figures of cost are given. —Lond. *Elec.*, April 6.

990-Volt Direct-Current Railway.—An illustrated description of the railway along the river Rhine between Cologne and Bonn, the total length being 28.3 kilometers. There are two trains per hour in either direction, the speed being 80 kilometers per hour. Each train contains not more than four cars, with a capacity for 250 passengers. It was required that within the city limits of Cologne and Bonn the 550-volt, direct-current of the municipal tramway lines be used. Three possibilities were considered: First a system proposed by the Allgem. Elec. Ges. using single-phase current at 6,000 volts between the cities and

550-volt direct-current within the cities; second, a system proposed by the same company, using direct current at 800 volts between the cities and 550 volts within the cities, and third, a system proposed by the Siemens-Schuckert Company using 990 volts direct current between the cities and 550 volts within the cities, the 990-volt current to be generated in a power plant near the center of the line. This last system was adopted for the following reasons: The single-phase system would have required a transformer in the car and the use of motors which could be operated both by the direct current in the cities and by the alternating current outside of the cities. It is stated that these requirements would have resulted in appreciably greater weight of the alternating-current cars compared with the direct-current. The single-phase system was, therefore, found to be less economical than the direct-current system. Savings in the feeders and the overhead construction on account of

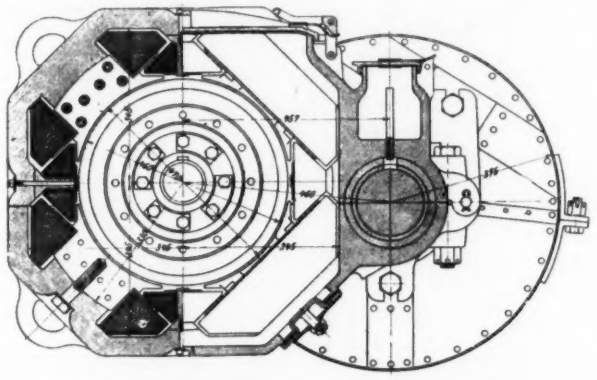


FIG. 1.—CROSS-SECTIONAL VIEW OF MOTOR.

the intended high voltage of the single-phase system were more than annihilated by the much more expensive equipment of the cars. Moreover with the direct-current system it is easy to use storage batteries. Finally the total length of the line, which is 22 kilometers, is too short to enable the single-phase system to show the advantages which it has on longer lines. The third rail was considered unsafe under the local conditions, and for this reason the overhead trolley wire system was adopted. Each motor car contains two 130-hp motors, designed for a speed of 700 revolutions per minute. Each motor car is able to draw one trailer. Several motor cars in one train are controlled by the

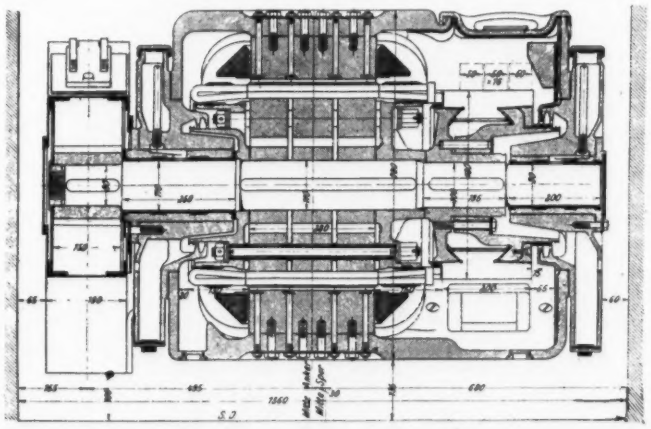


FIG. 2.—LONGITUDINAL SECTION OF MOTOR.

multiple-unit system. The direct-current motor used on the cars has four main poles and four interpoles. The design is shown in Fig. 1 and 2. The latter are of solid construction and in order to avoid eddy currents they are provided with slits towards the center. The armature current passes through the windings on the interpoles as well as through those of the main poles; when the direction of running is reversed the connections of the interpole windings are reversed together with the armature. The armature core has four ventilation slits. The gearing has the ratio of 1 to 3.1. The diameter of the running wheels is 950 mm. and the gauge is 1435 mm. The motors of one car are able to run a train consisting of a motor car and a trailer with a weight of about 54 tons at a speed of 70 km. per hour.—*Elek. Zeit.*, March 29.

Single-Phase Traction.—Some notes on the experiments made by the Oerlikon Company on the road from Seebach to Wettingen with 15,000-volt single-phase current. Originally it was intended to use two different systems, first a motor-generator locomotive on which the alternating current was changed to direct current by means of an induction motor coupled to a direct-current generator, the latter supplying direct current to the motors. The second locomotive is a straight single-phase locomotive with two commutator single-phase motors. It is now stated that the trials of the motor-generator locomotive have been abandoned. In the single-phase locomotive, current passes from the trolley to transformers, placed in the center of the locomotive; there the voltage is changed from 15,000 to 600, the capacity being 200 kilovolt-amperes. The secondary winding is divided into 20 steps which are used for regulating the speed of the motors, a special regulating switch being provided for this purpose. A second method of regulation is obtained by means of an induction regulator, the movable member of which is connected with the external 600-volt terminals of the transformer. It can be so adjusted that in the fixed member of the transformer a voltage between +150 and —150 may be induced, which is then combined with the motor tension of 400 volts. Both systems of regulation will be tested. Each motor (Fig. 3), running at 650 revolutions per minute has a capacity of 200 hp, and has eight laminated main poles and eight auxiliary poles. The main poles, 5, have compensating windings, 9, which may be either short-circuited on themselves or connected in series with the armature. The auxiliary poles, 7, have windings which are in series with each other and which are connected to the secondary winding, 13, of a main-current transformer. A resistance may be connected in parallel to the commutation pole winding to adjust the phase-difference. The ratio of gearing is 1 to 3.1.—*Elek. und. Masch.*, April 8.

Single-Phase Direct-Current Locomotive.—A very long illustrated account with drawings of the mechanical and electrical details of the first electric single-phase direct-current locomotive for the New York, New Haven & Hartford Railroad Company. Diagrams are given showing the performance of the locomotive and motors when operated by alternating current and direct current.—*St. R'y Jour.*, April 14.

Meters on Tramways.—An account of the use of meters on

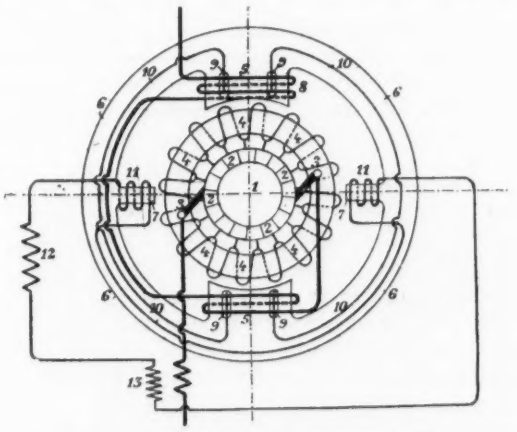


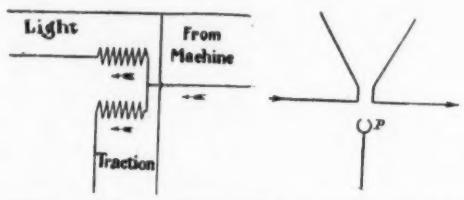
FIG. 3.—DIAGRAM OF MOTOR CIRCUITS.

the Frankfurt tramways. They first made experiments with kilowatt-hour meters and with recording meters whose record sheets were connected to the driving wheels. Much better results were obtained, however, with a recording meter whose sheet was driven by a clock mechanism. In 1905 all the tramways of Frankfurt were supplied with such meters and, although formerly the consumption of energy had increased from year to year, the introduction of the time meters resulted in an appreciable saving amounting to almost 13 per cent, the mean consumption now being 469 watt-hours per car-km. It is explained why such recording meters enable one to test the individual ability of the motorman. The advantages of the record-

ing meter over the energy meter are pointed out.—*L'Ind. Elec.*, March 25.

Installations, Systems and Appliances.

High Tension Installations.—Siedek.—A paper read before the Vienna Electrical Society, giving some details from modern high-tension plants. The Sill works furnish two-phase current for lamps and motors in Innsbruck as well as for traction on the Stubial Valley road. Since the current for lamps and for the traction motors is taken from the same machine and even from the same phase, it is necessary to use a special device for preventing voltage fluctuations in the lightning network. This is done by means of a "suction transformer" (Fig. 4), the primary



FIGS. 4 AND 5.—HIGH TENSION INSTALLATIONS.

winding of which is in series with the traction circuit while the secondary winding is in series with the lighting circuit. If a car starts, the traction current rises suddenly and this rise of current produces an increase of voltage in the lighting network which counterbalances the voltage drop which would occur without this device. The transformer has 380 turns from which some turns must be taken off, or to which some must be added, according to the different load in winter or summer. In the transmission system from the Morbegno plant, which utilizes the waterfalls of the Adda River, the high tension switches are of the simple form shown in Fig. 5. As soon as the connecting piece, *P*, is taken down the arc which is formed rises upwards along the two horns until it is broken in the well known manner.—*Elek. und Masch.*, April 8.

Manchester.—The first part of a fully illustrated description of recent extensions at the Manchester electricity works which comprises three generating stations. Among the most interesting additions which have been made to the plant are the 500-kw LaCour "cascade" motor-converters (which machine consists, as has repeatedly been mentioned, of an induction motor coupled to a direct-current generator, the rotor of the motor being electrically connected with the armature of the direct-current machine). Three of these machines have already been installed, and nine more have been ordered. This is thought to represent the largest industrial application of the new machine. The construction, design, and operation are described in detail.—Lond. *Elec.*, March 30.

Cost of Electricity for Private Plants.—Hartnell.—A paper read before the Leeds section of the (British) Inst. Elec. Eng., giving figures on the cost of electricity per kw-hour from private electric plants. Twelve numerical examples are discussed referring to flour mills, woollen mills, cloth factories, iron works, etc. In the examples given an increase on interest and depreciation from 10 per cent to 15 per cent adds as much to the cost per kw-hour as an increase of 50 per cent in the price of fuel. This cannot be taken as a general conclusion, but it points to the advisability of keeping down capital charges. The cost per kw-hour in the different examples varies between 0.5 and 3.2 cents.—Lond. *Elec.*, April 6.

Consumers' Records.—An illustrated article giving notes on the keeping of consumers' records in electric central stations. Forms of blanks are given.—Lond. *Elec. Rev.*, March 23.

Wires, Wiring and Conduits.

Wires.—Carter.—An article giving useful formulas on wires. The following formula is first developed: $c^2r \div d^3 = 2{,}614ht$; where c is the current in amperes, r is the resistance of the wire 1 inch long by 1 square inch in cross section in ohms, d is the diameter in inches, h is the number of British thermal units emitted from one square inch surface of wire per second per degree rise in temperature of the wire above its surroundings. t is the rise of temperature above the surroundings, h may be considered as fairly constant and equal to 0.000006. For instance, if the actual temperature of the wire is 250° F., then the rise above ordinary atmospheric temperature is $t = 190$, and the above formula gives $c^2r = 3d$. Several results are at once apparent from this. For instance, in wires of the same material r being constant, c^2 is proportional to d^3, or the current which gives a certain temperature rise is proportional to $d^{3\cdot2}$. This is a well-known fact, and is one of the most frequently used relations in working out resistances. Again, in two wires of different materials, if the current be the same in each, then for the same rise in temperature d^3 must be proportional to r or d is proportional to $r^{1\cdot3}$. If on the other hand the diameters are the same, the current, for a given temperature rise, is proportional to $r^{-1\cdot2}$, since c^2r is constant. If the equation is written $c = d^{3\cdot2}\sqrt{3/r}$ then the factor $\sqrt{3/r}$ can be determined for each source of wire and is a figure of merit for the material as regards its current-carrying capacity. This figure is 1830 for copper, 1330 for aluminum, 710 for iron, 420 for platinoid and manganin, 390 for eureka, 300 for resista, 290 for krupp, wolffin and beacon. A useful table, giving various figures for the materials just mentioned, is added.—Lond. *Elec. Rev.*, March 30.

Wooden Poles.—Soewit.—In order to prolong the life of wooden poles the author describes a method of protecting them by means of a cover of concrete at the point where the pole is inserted in the earth.—*Elek. und Masch.*, March 11.

Electrophysics and Magnetism.

Unilateral Electric Conductivity Over Damp Surfaces.—Trouton.—An abstract of a (Brit.) Phys. Soc'y paper. The author has noticed a rather perplexing difference in electrical resistance depending on the direction in which the measuring current is passed. The resistance under examination was that of a layer of moisture which adheres to glass when exposed to moist atmospheric conditions. The arrangement in which this resistance measurement was effected was one used for determining the temperature of deposition of dew. For this purpose two parallel wires of platinum were fused on to a glass surface at a small distance apart. The surface could be artificially cooled. A cell and a galvanometer were inserted in series with the two platinum wires. As soon as moisture condensed on the glass the circuit was completed and a current passed, thus permitting the accurate determination of the dew point. When a delicate galvanometer is used, a small current can be detected long before the true dew point is reached. It is at this stage that the anamalous behavior in the resistance is found. On passing a current across the glass surface when exposed to ordinary atmospheric conditions it was found to diminish to a certain minimum value, the amount of which depended on the hygrometric state. On reversal, the current assumed its original value and then diminished to a minimum as before, and so on for further reversals. In order more conveniently to study the matter with larger currents, tin-foil grids were prepared by pasting strips of tinfoil on to glass plates. Every second strip was connected to one pole of the battery while the intermediate strips were connected to the other. In this way was obtained a length of surface lying between parallel strips of tinfoil placed at a short distance apart. Grids of various widths were prepared. One set, consisting of eight glass plates with strips 0.2 cm. apart, gave a total length between electrodes of 250,000 cm. When an e.m.f. of 110 volts was applied, a current of about 0.0009 ampere was found to pass, but this gradually diminished to about 0.00015 amp. On reversal, the current was found to be about 0.0003 amp., which rapidly rose to about 0.0009 amp., and then diminished to about 0.00015 amp., and so on for further reversals. The resistance was measured by a Wheatstone bridge when the grid was in good conducting phase and when in a badly conducting phase, and found to be about 140,000 ohms and 800,000 ohms respectively. That the effects observed were not due to anything similar to ordinary polarization was shown by the fact that no back e.m.f. was obtained on short-circuiting through a galvanometer in the usual way, and also by the fact that the ratio of the currents in the two phases was independent of the dif-

ference of potential applied. Pressures up to 3,000 volts were applied. This would require a back e.m.f. of 1,500 volts to give a falling-off in current to half value. The theory put forward to account for the phenomenon depended on the transportation of moisture over the surface by the current. In this way the effective thickness of the layer might be much diminished by a banking up of the moisture along the edge of one of the metallic electrodes.—Lond. *Elec.*, April 6.

Effect of Heat on Radium Emanation.—Makower.—An account of experiments on the influence of temperature on the activity of radium emanation when in radioactive equilibrium with radium A, B and C, and when sealed up in a quartz tube so that there can have been no possibility of the escape of any volatile product. The results show clearly that the activity as measured by the beta and gamma rays can be changed by high temperatures, the observed effects being consistent with the explanation offered by Curie and Danne, the rate of decay of radium C is increased by high temperatures. The experiments do not, however, prove that it is this particular product which is affected, as the results could be equally well explained if one or more of the other radioactive bodies present underwent some alternation. The effect increases with the temperature up to 1,200° C. and with the time of heating, but not after the first hour. (The chief interest of these results rests in the fact that it had always been considered a characteristic feature of radioactivity that it cannot be influenced by any of the physical forces and agents at our disposal).—Lond. *Elec.*, March 30; from *Proc. Royal Soc.*, 516, March 6.

Magneto-Optics.—Zeeman.—A paper read before the Royal Inst. on recent progress in magneto-optics and the Zeeman effect.—Lond. *Eng'ing*, April 6.

Units, Measurements and Instruments.

Measurement of Resistance.—Jaeger.—A paper in which the author (who is a member of the Reichsanstalt) discusses the four chief methods of measuring resistances with the needle galvanometer, and points out the cases in which they can be used to the greatest advantage. In Thomson's method the resistance to be measured, A, should be nearly equal to the standard B. The ratio of the bridge resistance, a to A, should be very small. The galvanometer resistance, g, should be $A/2$. The sensitiveness is then $E/2\sqrt{2}$. In Wheatstone's bridge arrangement, the most favorable conditions are given by $a = A$, $B/A =$ infinite, $g = 2A$. The sensitiveness is then the same as in Thomson's method. The differential method is the most sensitive, when the conditions are favorable. These conditions are $b = A$, $ab/A^2 = 1$, $a/A = O$, $B/A =$ infinite, and $g = A$. The sensitiveness is then $\frac{1}{2}E$. The compensation method is the least sensitive under the most favorable conditions, which prescribe $b = a = A$, $a/A = B/A = 1$, and $g = A$. The sensitiveness is $\frac{1}{4}E$, E being the e.m.f. used. The differential method can be employed only with large resistances. If the resistance A and b can be changed simultaneously by the same amount, a sensitiveness $= E$ may be attained. With a movable coil galvanometer of half the sensitiveness of a needle galvanometer, the same delicacy of measurement of resistances can be attained.—Lond. *Elec.*, April 6; from *Zeit. f. Instrumenterk*, March.

Determination of Resonance Curves with the Cymometer.—Dyke.—An abstract of a British Phys. Society paper. The experiments described were made with a view to the adaptation of the direct-reading cymometer to the delineation of resonance curves and the determination of the logarithmic decrements of wave trains and the resistance of oscillating sparks. A special form of ammeter was inserted in the cymometer circuit, enabling the current to be observed for any position of the instrument. The ammeter used was of the hot-wire type with a bismuth-iron junction in contact with the hot wire, the e.m.f. of the junction and hence the current through the fine wire being read off from the deflections of a single pivot galvanometer of low resistance. The results of the work of Bjerknes and Drude on the oscillation transformer are referred to and the application of their final equations to the determination of logarithmic decrements from the resonance curves are discussed.—Lond. *Elec.*, April 6.

Direct Reading Ohmmeter.—An illustrated description of a compensated direct reading ohmmeter of French make which may be used in any location, for instance in the neighborhood of dynamos or pieces of iron or of cables carrying strong currents. It enables the direct measurement of the insulation of a line charged or not charged. The dial has a double scale, one measuring from 1 to 10 megohms (in which case the instrument is used in connection with a battery in the same case), the other measuring up to 5, 10 or 25 megohms, according to the voltage employed, the current being obtained in this case from an external source. The principle of the instrument is based on the well-known method of the voltmeter-ohmmeter. A source of e.m.f. E is in series with a resistance of comparison and a galvanometer. The greater part of the total resistance, R, is represented in the resistance of comparison. By closing the circuit, one gets a reading $a = kE \div R$. By inserting in the circuit the resistance, X, to be measured, one gets a second reading $a_1 = kE \div (R + X)$, hence $a_1 = aR \div (R + X)$. Since R is known and a has a fixed value, the reading, a_1 depends only on the resistance, X, to be measured, and the reading is independent of the e.m.f. E, and of the constant, k, of the galvanometer. Several applications are described. The article is illustrated.—*L'Industrie Elec.*, February 10.

Ballistic Galvanometer.—Smith.—A note on a mathematical Phys. Society paper on the damping of a ballistic galvanometer. A simple formula is given together with a method for determining the damping factor.—*Phys. Rev.*, April.

Determining the Self-Induction Coefficient by Weighing.—Flowers.—A letter giving some corrections of the formulas given by Peukert whose method by weighing was described some time ago in the Digest. Numerical results are given of an experimental investigation using the method of Peukert with the corrected formulas.—*Elek. Zeit.*, March 8.

Telegraphy, Telephony and Signals.

Wireless Telegraphy in War.—An illustrated article on wireless telegraphy in German Southwest Africa. In the beginning of the present Herero rising, heliographs were made use of extensively for the transmission of information between the various troop detachments and the camps, but this service was found useful only in the case of clear weather and over relatively small distances. Wireless telegraphy is free from this restriction and has later been proven very satisfactory. Three transportable stations have been used in German Southwest Africa, each being arranged for waves of two lengths, 350 and 1,050 meters, respectively, the same aerial being used in each case. The complete equipment comprises three two-wheeled vehicles, carrying the generating plant, apparatus and stores, respectively. Each car weighs about 600 kg, and can easily be hauled by one horse or mule. The equipment is described and illustrated.—Lond. *Elec Rev.*, March 23.

Miscellaneous.

Phantom Grounds.—Kintner.—A record of a test in which the armature of an alternator was believed to be grounded because the alternating current voltmeter connected with one terminal to ground indicated voltage when the machine was running. As a matter of fact there was no ground whatever. The phenomenon is explained with the aid of diagrams.—*Elec. Jour.*, March.

BOOK REVIEWS.

Hypochlorite und Elektrische Bleiche. By Dr. Emil Abel. Halle: Wilhelm Knapp. 110 pages, 10 Ills. Price, 4.50 marks.

The recent progress of electrochemistry from a technological standpoint is excellently illustrated in this little text-book on the theory of a particular branch of industrial operations involving the actions of hypochlorites and bleaching agents developed electrochemically. The treatment of the subject is distinctly chemical, and the book is written by an electrochemist for the use of advanced electrochemical students. The subject is a complex one and has only admitted very recently of quantitative discussion. The book will be welcomed by electrochemists and electrochemical students as a text-book on the subject dealt

with, and as a distinct advance in the literature of a process hitherto but little understood.

Bookkeeping by Machinery. By E. W. Thompson. New York: Published by the author. 176 pages, illustrated. Price, $2.00.

A great many people think of a bookkeeper as at best only an animated machine, and it is a fact that machinery will do pretty nearly every feat, and just as rapidly, that the "lightning calculator" of the music halls will do. The principles of Babbage carried out far enough should give us some day the results, if not the reasoning, of the star mathematicians, for anything that proceeds from determined data and distinct postulates to a definite conclusion is but mechanical. It will, of course, still be left for talented trust magnates and absorptive insurance presidents to let their imaginations play over the statistics, and show what can be done with the inherent values.

Meantime, bookkeeping by machinery is becoming almost as much of a truism as business by method, and each needs its own literature. Here we have a clever and competent work, written in a distinterested way, to show how the genius of the inventor has virtually abolished the human side of bookkeeping and rendered everything possible to the machine side. Needless to say, electricity plays quite a large part, and the office that has its electrical and other apparatus here described is deprived of any excuse for not paying its bills promptly because the treasurer is sick or in the West Indies.

And yet, noting carefully all the skillful mechanism here brought to account on the credit page of human advance, the feeling arises that, after all, the demand on the men who administer systems like these becomes greater rather than less. It is still much easier to write a letter by hand than "type" it. The tallow candle, if brought out to-day would be declared the most wonderful illuminant the world has ever seen, and the brain has not yet abdicated to the "wheels" of a Frankenstein creation. In brief, all these ingenious devices are auxiliaries, to be adopted from that standpoint as indispensable, but not dispensing anybody from attending personally to business just as sedulously and as strictly as Astor when he lived over his store.

Sumter "Unitype" Telephone Switchboard.

The Sumter Telephone Manufacturing Company, Sumter, S. C., has placed on the market a switchboard known as the "Unitype," which embodies several new features. One of these is the type of drop, a side elevation of which is shown in Fig. 1.

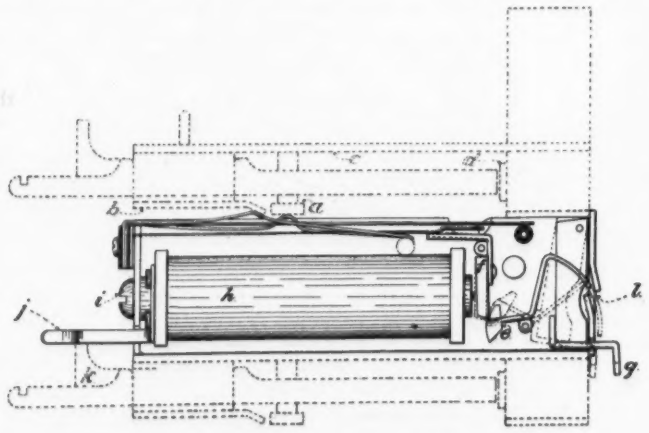


FIG. 1.—DIAGRAM OF DROP.

The armature *F* of a drop hangs in front of the coil *H* and is balanced on a brass rod which runs entirely across the frame; this mounting obviates the necessity for pivot screws, a fruitful source of trouble. The shutter, *E*, which is very light, is held in its normal or unexposed position by a knife edge on the armature engaging a small projection on the bottom of the shutter. When the armature is attracted by the coil, the shutter is released from the knife edge and falls forward and projects through the slot, *L*, in front of drop case, thus giving the signal to the operator. The signal is thus displayed by the force of gravity alone and does not depend upon any electrical means except for the short space of time the drop winding or coil

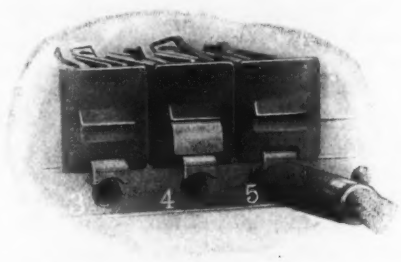


FIG. 2.—FRONT VIEW OF THREE DROPS.

is energized by the current from the calling telephone. The dotted lines in Fig. 1 show the drop after a call has been received and Fig. 2 gives a front view of three drops. The

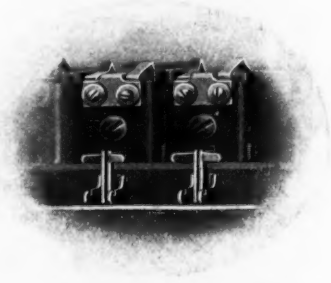


FIG. 3.—REAR VIEW OF DROPS.

method of inserting the drops in the board is new, there being no wires connecting to them in any manner. Fig. 3 gives a rear view of a couple of drops, showing the locking contact springs

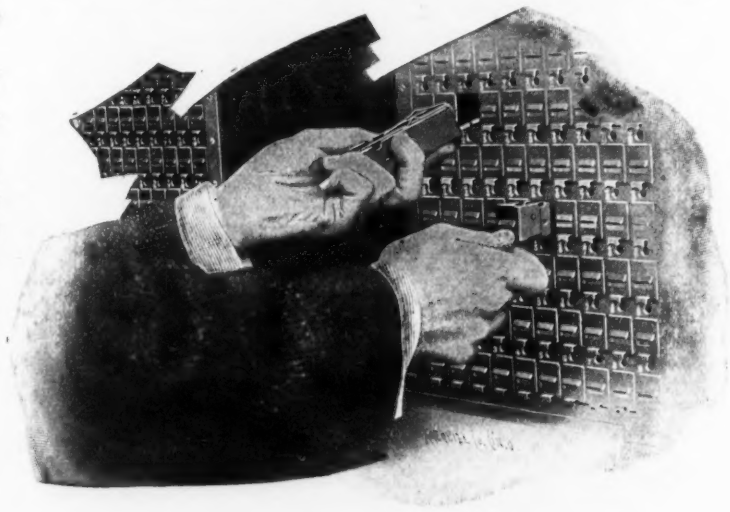


FIG. 4.—METHOD OF REMOVING AND INSERTING A DROP.

connecting the drop to the jack. Fig. 4 shows the manner in which a drop is removed or inserted in the switchboard; it is simply pulled out or pushed in and it is only the work of an instant to change the drop from one position to another.

Adjustable Switch Box.

R. E. Yonge, Jr., of Jacksonville, Fla., has designed an adjustable switch box as shown by Fig. 1 herewith, for which many advantages are claimed. As superintendent of the construction department of the Florida Electric Company Mr. Yonge had often felt the need of some such appliance, since when installing switch boxes in the wall prior to the application of the finishing coat, it was often found that variations in the

thickness of this coat rendered it impossible to place the switch plate snug against the switch unless the plaster was cut away, which was not always desirable. The switch box is made in two

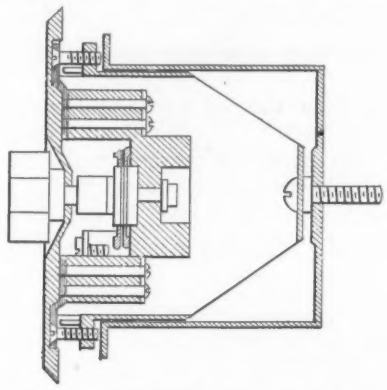
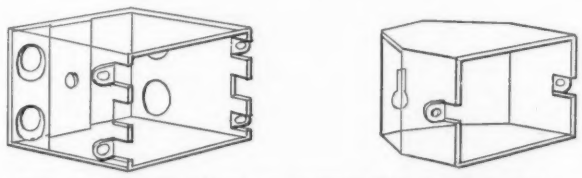


FIG. 1.—ADJUSTABLE SWITCH BOX.

parts as shown by Figs. 2 and 3, one part sliding within the other. The permanent portion is fastened to the wall in the usual manner by screws passing through lugs provided for them. The adjustable portion is fastened to the permanent portion by means of the machine screw shown. The two lugs are adapt-



FIGS. 2 AND 3.—PARTS OF ADJUSTABLE SWITCH BOX.

ed to slide in the recesses provided for them in the permanent portion, and the switch is fastened to the telescopic portion by means of screws fastened to these lugs. Before the switch is inserted, however, the telescopic member is adjusted by means of the machine screw so that the switch plate will come snug up against the switch.

Electric Power in the Manufacture of Railroad Frogs.

The shops of the Weir Frog Company, located in Norwood, Ohio, a suburb of Cincinnati, furnish an excellent example of the application of electric power to manufacturing purposes.

FIG. 1.—LINE OF MOTOR-DRIVEN PLANERS.

Every machine tool in the great shop, which is a single-story brick structure 720 ft. by 125 ft., is operated by an electric motor; and with the exception of a few small machines taking power from two lines of motor-driven shafting every tool is driven by its own motor.

The erecting and main machine floor is 125 ft. by 340 ft. and is served over its entire length by two electric cranes, one of

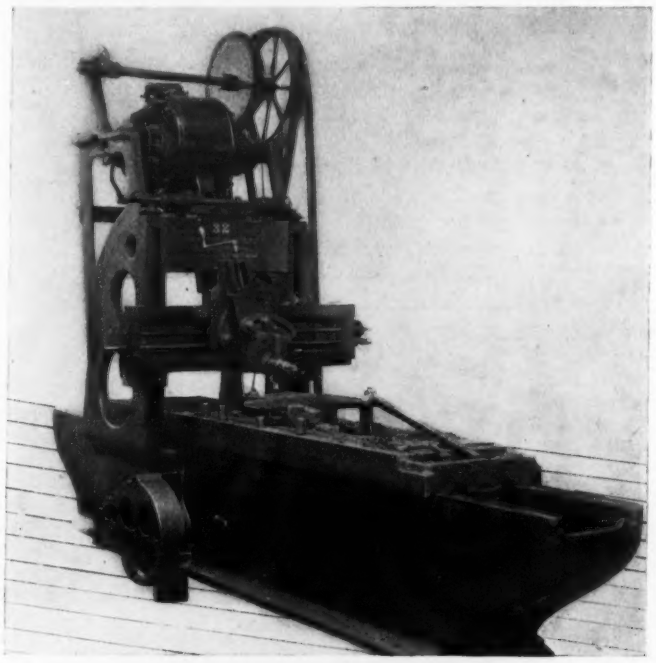


FIG. 2.—MOTOR-DRIVEN PLANER.

which is used largely in loading and unloading freight cars. The second crane supplies the erecting floor and machines with

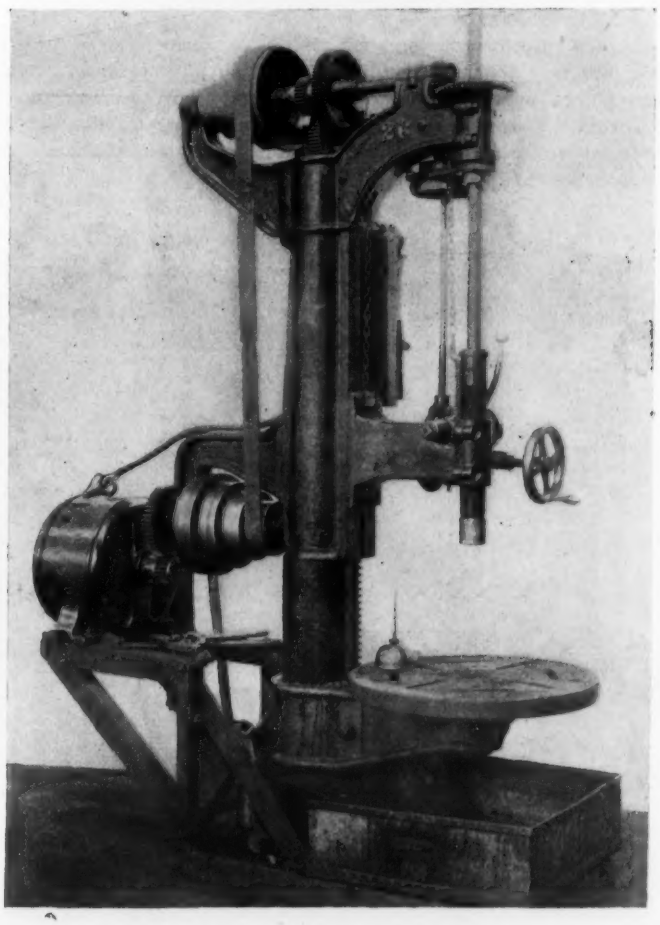


FIG. 3.—MOTOR-DRIVEN VERTICAL DRILL.

material from the stock department, which is located just beyond the floor. The power plant consists of a 500-hp compound engine directly coupled to a 300-kw, 220-volt, Allis-Chalmers direct-current generator.

The accompanying illustrations show some of the motor-driven

tools. Fig. 1 shows a line of motor-driven planers and Fig. 2 a motor-driven planer of another type. Fig. 3 illustrates the

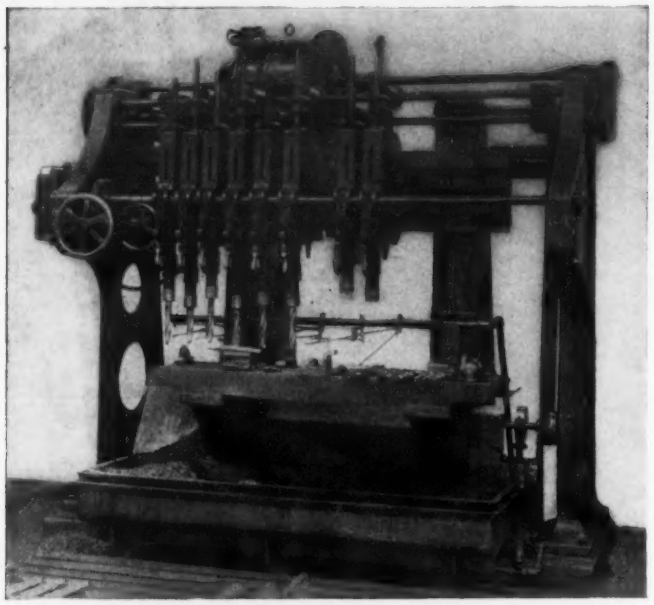
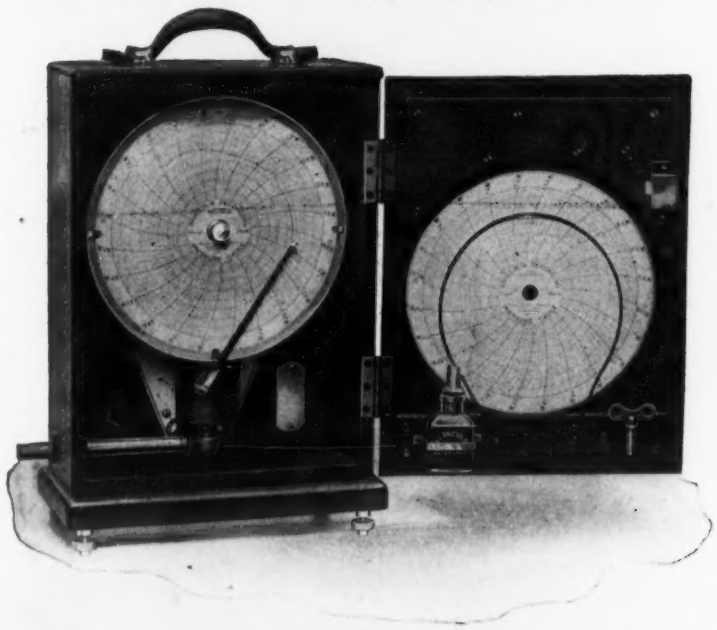


FIG. 4.—MOTOR-DRIVEN VERTICAL MULTI-SPINDLE DRILL.

mounting of a motor for a vertical drill, and Fig. 4 shows the method of motor mounting to a multi-spindle drill.

Portable Recording Steam Gauges.

In response to a demand for a light, compact, portable recording pressure gauge, the Bristol Company, Waterbury, Conn., has placed upon the market a modification of the well-known recording gauge, which is free from delicate mechanism so that an ordinary workman can manipulate it successfully with reasonable care. In the portable type of gauge, a view of which



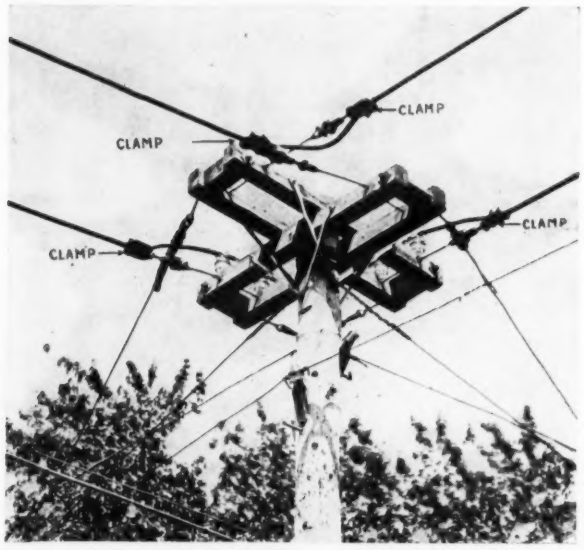
PORTABLE RECORDING GAUGE.

is given in the accompanying illustration, the metal arc has been omitted. The pressure tube and clock for driving the chart are mounted on a light aluminum back which is in turn mounted in a wooden carrying-case designed with special reference to ease in handling and in making connections.

Two forms have been developed. One of these is used when the pressure may exceed five pounds per square inch, while the other is employed for very low pressures. The latter form is capable of recording pressures as low as that due to a one-twentieth of an inch head of water. Each form is furnished with leveling screws to facilitate adjustment, and provision is made for carrying charts and ink with the instrument.

Cable Clamps in Service.

The accompanying view of a pole in Topeka, Kansas, clearly illustrates the method used by the Topeka Railway Company in turning a corner with two 500,000 cm. cables, by the use of four Kearney cable clamps. This company has used almost 1,000 cable clamps of this type during the past two years, and has found that the cables can be placed in position in much less time



CABLE CLAMPS IN SERVICE.

than is required with the old method of splicing the cable or serving strands around it. Moreover, the final result is in each case an extremely neat and strong piece of line work when the cable clamps are used. These clamps are manufactured by W. N. Matthews & Bro., 227 N. Second Street, St. Louis.

High-Efficiency Incandescent Lamps.

The Tipless Lamp Company, of 256 West 23d Street, New York, has developed and placed on the market a line of 2½-watt metallic filament incandescent lamps in 12, 16, 20 and 25-cp. sizes for various voltages up to 130. The company has also brought out an 8-cp, 2½-watt metallic filament lamp for train lighting service which is used extensively on the New York Central and other large trunk lines having electrically-

METALLIC FILAMENT LAMP FOR TRAIN LIGHTING SERVICE.

lighted coaches. The president and manager of the company, Mr. H. J. Jaeger, has experimented with metallic filaments since 1894, and for the past seven years has marketed miniature lamps containing metallic filaments. The present high-efficiency lamp marks the culmination of his experiments along this line. The carbon filament as at present made is employed as a cathode on which the metal is deposited, the process being secret; the filament is then subjected to a high heat. The lamps are claimed to have a life equal to that of the 3.1-watt incandescent

lamps on the market; the lamp for train lighting service, which is shown in the accompanying engraving, is stated to have a life of from 400 to 500 hours.

Solid Insulation for Underground Conductors.

An improved form of the wooden conduit system which is being largely used by electrical engineers in Germany for the installation of underground conductors is being introduced by the Electric Cable Company, of New York City. In this system extensive use is made of Voltax, the new insulating material, which was noted in our issue for February 17, 1906, when a report was given of tests made by the Electrical Testing Laboratories of New York City, showing its high dielectric strength and specific

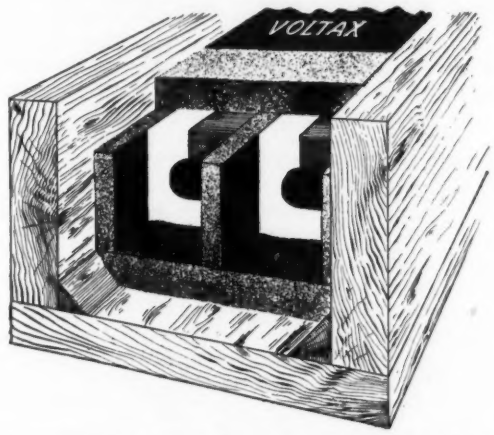


FIG. 1.—PERSPECTIVE VIEW OF THE CONDUIT SYSTEM.

resistance, which are prime requisites in the insulation of high and low-tension conductors.

In making the installation according to the above system a wooden trough is laid in a trench about 18 in. deep. Porcelain carriers are placed in this trough at intervals of four or five feet, acting as bridgework for supporting the conductors. As shown in Fig. 1 the bridgework rests on, and is surrounded by, impregnated felt or similar material, the space between the carriers, after the conductors have been placed in position on them, being filled with Voltax, which rapidly hardens, thus creating a solid insulating material throughout the entire conduit.

Connections to the conductors are easily made by opening the trench at any desired point and melting the Voltax by means of a blow torch. After the connection has been made the trough is again filled with the insulating material, and the continuity of

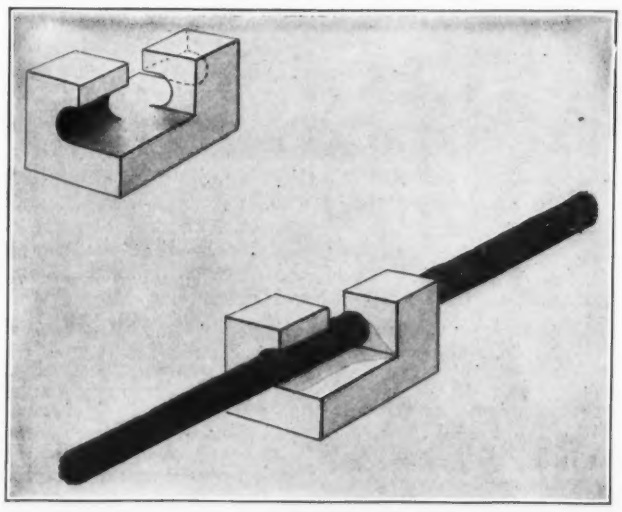


FIG. 2.—TYPE OF PORCELAIN BRIDGE WORK FOR CARRYING THE CONDUCTORS.

the insulation of the system is thus re-established, perfect connections being secured by this means.

The tests referred to indicated, among other things, that Voltax is impervious to atmospheric conditions, water, acid and alkali, thus making this new insulating material particularly desirable for use in connection with underground conductors.

It is stated that installations made according to the system outlined above involve an outlay one-third less than those made according to the duct system. The objection still existing in some quarters against the solid system of insulation, based on the

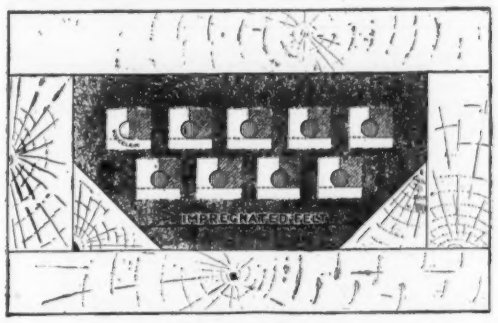


FIG. 3.—CROSS-SECTION OF CONDUIT.

ground that it is not possible to increase its capacity as readily as that of a system in which idle ducts can be laid, is readily overcome by the fact that a solid system embodying two or three conductors is less expensive to install than a duct system with its cost for annual maintenance and extra ducts, the interest on the idle wires being considerable less than the maintenance and duct charges.

Dry Battery Fan.

The electric fan shown in Fig. 1 has been designed for use in places where electricity cannot be obtained directly from lighting circuits. The equipment consists of a 10-in. brass fan provided

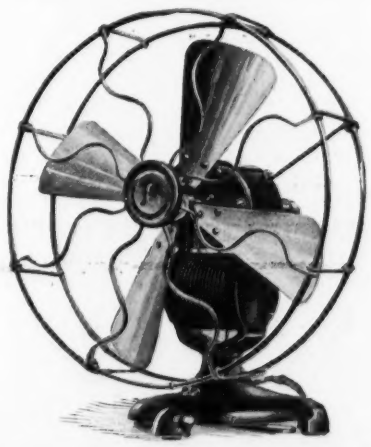


FIG. 1.—LOW-VOLTAGE, DIRECT-CURRENT FAN.

with well-protected blades and driven by a direct-current motor, the energy for which is obtained from a battery of dry cells arranged in a portable form (Fig. 2). It is stated that one set of cells will operate the fan for from 250 to 350 hours, which,

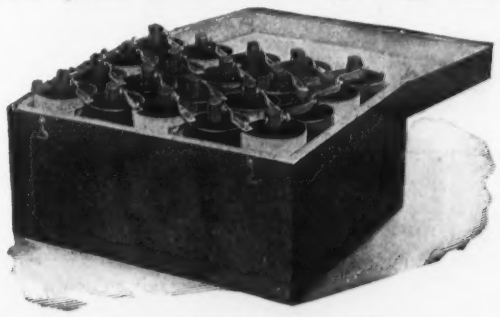


FIG. 2.—PORTABLE DRY BATTERY.

under ordinary conditions, will be more than sufficient for one summer season. This portable fan outfit is manufactured by the Jones Electric Company, 62 Vesey Street, New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The appalling disaster in San Francisco was the thought uppermost in the minds of the people last week, and to some extent had a disturbing effect upon business in many lines. The first news seemed so incredible that it paralyzed everyone, but when the true situation became known, forces were set to work with the utmost vigor to aid the inhabitants of the stricken city, and out of San Francisco's great misfortune will arise an activity in business that will be felt for a long time to come. It was recognized that the disturbance, though unprecedentedly hurtful, has been confined to a comparatively small area of country, and the rest of the nation, contemplating, as it does, prospects of bountiful crops and another year of great prosperity, finds itself alike willing and able to give freely of its abundance to help the stricken city and State. Aside from this, practically every trade and news feature of the week was satisfactory. Crops, trade and industry, excepting only the coal situation, improve with the weather and the natural spring tendency to expansion. Retail trade shows considerable stimulus as the result of warmer weather, and this in turn has resulted in much reordering to fill in stocks. Iron and steel conditions are even more favorable; railway earnings are heavy; collections tend to improve, and money is certainly easier, though still in active demand. Freer sales of pig iron; more inquiries; firmer prices; further sales of steel rails; growing congestion at the rail mills; the booking of business for 1907 delivery by a leading Southern interest at $29 a ton, the placing of contracts for upward of 200,000 tons of steel bars by agricultural implement makers—the business having been closed on a concession and more moderate trade in structural material, due probably to the housesmiths' strike—are the week's most important developments in the iron and steel industry. Copper continues firm, and there is said to be very little April or May copper available. Coal is comparatively quiet, the miners' trouble having little influence, supplies being ample, and coke on the whole is probably less active, though prices are firm. Business failures during the week ending April 19, as reported by *Bradstreet's*, numbered 167, against 161 the week previous and 183 the corresponding week last year.

ALLIS-CHALMERS MOTOR EQUIPMENTS.—The Allis-Chalmers Co. has recently received a number of orders for its Bullock generators and motors, to be built at the Cincinnati works. The Atlas Portland Cement Company, of Northampton, Pa., recently purchased two 50-hp motors for the operation of cement machinery. The Hammermill Paper Company, of Erie, will install a 150-kw generator and a 175-hp motor, recently ordered. The Ellsworth Coal Company, of Ellsworth, Pa., recently purchased a three-phase, 25 cycle, 600-volt, 500-kw rotary converter for general mine service. The American Steel & Wire Company, of Chicago, will install at Anderson, Ind., a 200-kw generator recently purchased. The Anderson & Middleton Lumber Company, of Aberdeen, Wash., has recently ordered a 125-kw generator, 120 volts, 350 r.p.m., for direct connection to a 9x9-in. automatic engine. The Tuttle Press Company, of Appleton, Wis., will install a 10x24-in. horizontal Reynolds Corliss engine, Reliance type and a 45-kw, D. C. belted generator. Thomas C. Basshor & Co., of Baltimore, Md., recently purchased three 16-30-in. Reynolds Reliance Corliss engines for direct connection to 150-kw generators to be installed at Atlantic City, N. J., for the Nixon Amusement & Realty Company. These engines will run non-condensing at 150 r.p.m., 100 lbs. steam pressure.

GAS ENGINES FOR RAILWAY SERVICE.—The Westinghouse Machine Company, of East Pittsburg, Pa., has recently contracted with the Olean Street Railway Company to install in their power house at Ceres, N. Y., two gas engines for supplying current to the Olean Street Railway, serving Olean, Ceres, Boliva, etc. In the near future, current will also be supplied to an interurban railway system between Olean and Salamanca, N. Y., a distance of 15 miles. The engines are to be of the Westinghouse horizontal heavy duty double acting type, with single cranks, and cylinder 22-in. in diamater by 30-in. stroke. Each unit will have a normal capacity of 500 brake hp, running at 150 revolutions per minute. They will operate on natural gas having a calorific value of approximately 1,000 B.t.u. This fuel is very plentiful in the region. The engines are to drive 300 kw, 25-cycle alternating current generators, operating in parallel and supplying current at 380 volts to a high-tension three-phase transmission distribution system through step-up transformers. At present the Olean Street Railway Company has a steam power plant in service burning gas under the boilers, and a large saving is contemplated in using gas power.

SALES OF BALL ENGINES.—The Ball Engine Company, of Erie, Pa., reports the following recent sales of Ball engines: Fruit Growers' Refrigeration & Power Company, Anna, Ill., one 200-hp engine; Central Ice Company, Mounds, Ill., two 150-hp simple engines; National Tube Company, Pittsburg, Pa., one 700-hp cross-compound Corliss engine; Burnham Brothers, Milwaukee, Wis., one 60-hp simple engine; Oliver Iron Mining Company, Hibbing, Mich., four 100-hp single cylinder engines; James W. Ellsworth & Company, Cleveland, O., two 400-hp simple engines; Erie County Electric Company, Erie, Pa., one 70-hp center crank engine; Norristown Electric Light & Power Co., Norristown, Pa., one 400-hp single cylinder engine; Worcester Polytechnic Institute, Worcester, Mass., one 350-hp vertical cross-compound engine; Young & Summers, Lima, O., one 350-hp horizontal cross-compound engine.

LARGE ELECTROLYTIC GENERATOR.—The American Can Company, of Paulsboro, N. J., will install a 20x42x42-in. horizontal cross compound engine, direct connected to a 500-kw engine type electrolytic generator and a switchboard, recently purchased from the Allis-Chalmers Co., Milwaukee. The engine will run condensing at 135 lbs. steam pressure and 100 r.p.m. It will be equipped with a special speed changing device for varying the speed so that the generator voltage may be governed over a range of 100 to 200 volts. The generator will be a 14-pole machine, 500 kw, 200 volts. The shunt field coils will be so proportioned as to allow for increases in voltage between 100 and 200 volts, by approximately equal increments by varying the speed of the engine and by rheostat, the output in amperes being constant at 2,500 throughout the range.

REYNOLDS CORLISS ENGINE ORDERS.—The Falk Co., of Milwaukee, whose steel foundries are among the largest in the State, has recently purchased new equipment for the plant from the Allis-Chalmers Co., Milwaukee, consisting of a 20x42x42-inch. Reynolds heavy duty, cross compound, Corliss engine, a 550-kw, D. C. engine type generator, an 18x36-in. steam, 30x18-in air, 42-in. stroke Reynolds heavy-duty, cross-compound air compressor; two Tomlinson barometric tube condensers, 32 x 24 in. respectively, together with centrifugal pumps, boilers, switchboards, etc. The J. B. & J. M. Cornell Co., of New York City, recently purchased an 18x36-in. Allis-Chalmers Reynolds girder Corliss engine for re-shipment. The Pittsburg Reduction Company, of Bauxite, Ark., is also a recent purchaser of a 20x36-in. Reynolds Reliance Corliss engine.

OUTPUT OF COPPER.—Copper production in the United States for the first quarter of 1906, it is estimated, amounted to 250,000,000 pounds in round figures, or at the rate of 1,000,000,000 pounds per annum. Copper production in the United States for the year 1905 was estimated at 950,000,000 pounds, an increase of 16 per cent. over 1904. It is estimated that Mexico will produce this year 150,000,000 pounds of copper, and British Columbia about 50,000,000 pounds. Hence the production of copper from the American continent in 1906 will amount to 1,200,000,000 pounds. The production for 1905 was between 1,050,000,000 and 1,100,000,000 pounds.

A 4,000-HP OIL ENGINE INSTALLATION.—The Baldwin Locomotive Works, who recently ordered 26 125hp "Hornsby-Akroyd" oil engines have just placed an order for six more of these engines of the same size, or a total of 32 engines, some of which will be coupled together and run direct connected to electric generator, making 250 hp units. Aggregating 4,000 hp, this will be the largest oil engine installation ever made. These engines will be run on crude oil, and are all supplied by the De La Vergne Machine Co. of New York.

Financial Intelligence.

THE WEEK IN WALL STREET.—After wavering uncertainly on Wednesday, when news of the San Francisco earthquake and fire first came in, the markets fell on Thursday into extreme weakness, with numerous declines of 5 to 10 points in active securities. Even at London, it was reported that financial markets were upset by the San Francisco news. Later the market became firmer on renewed support and short covering. Heavy liquidation occurred in pool stocks as well as in transcontinental rails. Easier money, due to large imports of gold, abated the stringency, Secretary Shaw's action in facilitating gold imports enabling New York to arrange for a large flow of money to the Pacific Coast. Electric securities declined with the rest of the market, and while there were some recoveries none of them regained the losses sufficiently to come out even, with the exception of Westinghouse, which made a net gain of 2¼ points. The closing price was 164, which was also the highest for the week. General Electric fell to 167, but regained some of the loss and closed at 169⅛, a net loss of 2⅞ points. Allis-Chalmers common closed at 22, and preferred at 56½, the latter being a decline of 1 point. Among the tractions the lowest quotation for Metropolitan Street Railway (154½), was also the closing price, and represents a loss of ½-point for the week's business. There was active trading in Brooklyn Rapid Transit, but on a falling market. The lowest price was 82½ and the highest 89, the quotation at the close being 84⅜—a net loss of 3½ points. In the telegraph list, Western Union remained steady at 92⅛ throughout the week, and the same condition was recorded as to American Telephone & Telegraph, the unvarying price being 138. American Locomotive closed at 68¼ for common and 114½ for preferred, these quotations being a net gain of ⅛-point for the former and a net less of ½ for the latter. Curb stocks felt the effect of the San Francisco disaster, and business was almost at a standstill as far as public buying was concerned. Interborough-Metropolitan lost 1½, in closing at 52½ and preferred 2⅛, the closing quotation being 88. Mackay Companies closed at 65, which is a net advance of ⅛-point. Following are closing Stock Exchange quotations of April 24:

NEW YORK

	Apr. 17	Apr. 24		Apr. 17	Apr. 24
Allis-Chalmers Co.	22¼	20⅝	General Electric	171¼	166⅛
Allis.Chalmers Co. pfd.	57⅛	56⅛	Hudson River Tel.	...	...
American Dist. Tel.	*39	*39	Interborough Rap. Tran.	...	226
American Locomotive	69⅛	64¼	Mackay Cos.	65	63⅛
American Locomotive pfd.	115	113⅜	Mackay Cos pfd.	73¼	72¾
American Tel. & Cable	92	92	Marconi Tel.	...	...
American Tel. & Tel.	137	137⅛	Metropolitan St. Ry.	116¾	112½
Brooklyn Rapid Transit	87⅛	81⅛	N. Y. & N. J. Tel.	...	...
Electric Boat	...	18	Western Union Tel.	92¼	92¼
Electric Boat pfd	...	65	Westinghouse com.	163	156
Electric Vehicle	...	15⅛	Westinghouse pfd.	...	...
Electric Vehicle pfd.	19⅛	17½			

BOSTON

	Apr. 17	Apr. 24		Apr. 17	Apr. 24
American Tel. & Tel.	138½	137½	Mass. Elec. Ry. pfd	67	66
Cumberland Telephone	...	...	Mexican Telephone	...	...
Edison Elec. Illum.	...	...	New England Telephone	140¾	138⅛
General Electric	...	...	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	20	18⅛	Western Tel. & Tel pfd.	84½	...

PHILADELPHIA

	Apr. 17	Apr. 24		Apr. 17	Apr. 24
American Railways	53½	52	Phila. Electric	8¼	8⅛
Elec. Co. of America	11¼	11¼	Phila. Rapid Trans.	28¼	27⅝
Elec. Storage Battery	78	75	Phila. Traction	99¼	99
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Apr. 17	Apr. 24		Apr. 17	Apr. 24
Chicago City Ry.	152	150	National Carbon	92	90
Chicago Edison	154⅛	...	National Carbon pfd.	118	120
Chicago Subway	56¼	55⅛	Union Traction	...	...
Chicago Tel. Co.	110	107⅛	Union Traction pfd	...	...
Metropolitan Elev. com.	26	26			

* Asked

DIVIDENDS.—American Light & Traction Co. has declared the regular quarterly dividends of 1½ on the preferred stock and 1 on the common, payable May 1. The preferred dividend of 1¾ per cent. on National Carbon is payable May 15. The regular quarterly dividend of 1¾ per cent. has been declared on the preferred stock of the American Graphophone Co., payable May 15. Directors of the North American Co. have declared the regular quarterly dividend of 1¼ per cent., payable June 1 to stockholders of record on May 15. The Helena Light & Railway Company's directors have declared a dividend of 1¼ per cent. on the preferred stock for the quarter ending March 31, 1906, payable April 30. The directors of the Amalgamated Copper Company have declared a regular quarterly dividend of 1½ per cent and an extra dividend of ¼ of 1 per cent without any extra dividend. At that time the regular rate was increased from 1¼ per cent. quarterly to 1½ per cent. quarterly, placing the stock on a 6 per cent. basis. The Montreal Light, Heat & Power Co. has declared a quarterly dividend, payable May 15 at the rate of 4 per cent per annum. The Twin City Rapid Transit Company has declared the regular quarterly dividend of 1¼ per cent on common stock, payable May 15.

CINCINNATI GAS & ELECTRIC.—A lease of the business and plant of the Cincinnati Gas & Electric Company for ninety-nine years to A. S. White and associates of New York has been ratified by the board of directors of the company. A holding company will be formed under the laws of Ohio to take over the local company, and the new corporation will have a capital of $10,000,000. Of this amount $6,000,000 will be issued and the balance will be retained by the syndicate. The new stock will be sold to provide funds to build a pipe line from this city to the natural gas fields of West Virginia. The leasing company is also to guarantee $3,000,000 in cash to the old company, and an expenditure of $2,000,000 on improvements in the next ten years. In addition 5 per cent dividends are to be guaranteed on the present outstanding capital of the Cincinnati Gas & Electric Company, which is $36,000,000, of which $31,000,000 is outstanding.

ELECTRIC LIGHTING REPORTS.—Stone & Webster, of Boston, report the earnings of the following companies for the month of February, 1906, also for the twelve months ending Feb. 28, 1906:

	1906.	1905.		
Edison Electric Illuminating Co., of Brockton:				
February gross	$14,285	$11,853	Inc.	$2,432
February net	4,301	2,995	Inc.	1,306
February sur. over chgs.	3,572	2,326	Inc.	1,246
Twelve months' gross..	150,289	125,976	Inc.	24,313
Twelve months' net....	44,177	49,743	Dec.	5,566
Twelve months' surplus over charges	35,605	39,544	Dec.	3,939
Jacksonville Electric Co.:				
February gross	$22,371	$23,916	Dec.	$1,545
February net	7,647	10,300	Dec.	2,653
Feb. sur. over chgs.	4,322	7,283	Dec.	2,961
Twelve months' gross..	303,447	297,417	Inc.	6,030
Twelve months' net ...	121,871	120,193	Inc.	1,678
Twelve months' surplus over charges	83,398	83,680	Dec.	282
Lowell Electric Light Corporation:				
February gross	$24,099	$20,791	Inc.	$3,308
February net	10,912	10,491	Inc.	421
Feb. sur. over chgs.	10,222	9,560	Inc.	662
Twelve months' gross..	261,714	240,962	Inc.	20,752
Twelve months' net....	100,094	104,182	Dec.	4,088
Twelve months' surplus over charges	91,253	89,697	Inc.	1,556
Savannah Electric Co.:				
February gross	$45,821	$39,491	Inc.	$6,330
February net	16,574	15,814	Inc.	760
Feb. sur. over chgs.	5,670	5,260	Inc.	410
Twelve months' gross..	600,844	546,634	Inc.	54,210
Twelve months' net....	240,991	228,906	Inc.	12,085
Twelve months' surplus over charges	112,595	102,427	Inc.	10,168
Houghton County Electric Light Co.:				
February gross	$19,889	$18,323	Inc.	$1,566
February net	10,038	10,744	Dec.	706
Feb. sur. over chgs.	7,851	8,557	Dec.	706
Twelve months' gross...	218,984	189,434	Inc.	29,550
Twelve months' net....	113,859	92,254	Inc.	21,605
Twelve months' surplus over charges	87,609	66,004	Inc.	21,605
Minneapolis General Electric Co.:				
February gross	$71,250	$56,106	Inc.	$15,144
February net	39,454	27,712	Inc.	11,742
Feb. sur. over chgs.	30,404	17,260	Inc.	13,144
Twelve months' gross..	750,610	648,454	Inc.	102,156
Twelve months' net....	358,809	325,280	Inc.	33,529
Twelve months' surplus over charges	248,986	212,064	Inc.	36,922
Tampa Electric Co.:				
February gross	$35,873	$30,590	Inc.	$5,283
February net	16,551	12,186	Inc.	4,365
Feb. sur. over chgs.	16,551	10,285	Inc.	6,266
Twelve months' gross..	423,746	374,774	Inc.	48,972
Twelve months' net....	184,186	152,738	Inc.	31,448
Twelve months' surplus over charges	166,258	129,428	Inc.	36,830
Terre Haute Traction & Light Co..				
February gross	$54,902	$40,746	Inc.	$14,156
February net	18,706	10,047	Inc.	8,658
Feb. sur. over chgs.	6,074	950	Inc.	5,124
Twelve months' gross..	657,500	574,927	Inc.	82,573
Twelve months' net ...	228,521	205,300	Inc.	23,222
Twelve months' surplus over charges	101,114	92,297	Inc.	8,819

NEW ORLEANS LIGHTING.—The New Orleans Railway & Light Company in its annual report just issued by President E. C. Foster, gives the gross earnings as $5,093,709; operating expenses, $2,671,460; the fixed charges and taxes, $1,784,226, and

the surplus $638,023. The separate earnings, etc., of the lighting system are not given, but it is stated that during the last three years $255,042 has been spent on additions to electric light properties, $147,475 on arc lamps, meters, transformers, etc., and $108,244 on new plant for city lighting. A considerable amount of new electric lighting work is to be done at an early date. The gross earnings of January, 1906, were $498,578, and of February, $506,507, leaving a surplus for the two months of $210,841, or more than the preferred dividend for the whole first quarter.

CONSOLIDATION OF STATE OF WASHINGTON RAILWAY COMPANIES.—The plan of a merger of the Coeur d'Alene & Spokane Railway Company, the Spokane Traction Company and the Spokane & Inland Railway Company to form the Inland Empire Railway of Spokane, provides for the issue of $10,000,000 each of common and preferred stock. The preferred stock will be 5 per cent non-cumulative for the first five years, and after that cumulative with a provision that in case of more than a 5 per cent dividend being paid upon the common stock an increased dividend not to exceed 7 per cent shall be paid. The preferred stock, the par value of which is $100, is to be redeemable at the pleasure of the corporation at any time at $135 per share, but is to have no vote. It is planned to issue at the present time about $6,000,000 of the common stock, the amount remaining after taking over the capital stock of the merging companies to be used for the establishment of a hydro-electric plant of the Spokane River near Spokane, and the building of an electric railway to connect the same with Spokane. The Coeur d'Alene & Spokane Railway has been in operation for about two years and runs between the cities after which it is named—a distance of about 33 miles. The Spokane Traction Company has 22 miles of track in Spokane, a considerable part of which has been in operation for less than a year. The Spokane & Inland Railway will run from the former place to Colfax and Palouse and have a total mileage of 115 miles, the lines being now under construction.

GROWTH IN EARNINGS.—The Milwaukee Electric Railway and Light Company reports for March:

	1906.	1905.		
Gross earnings	$274,026	$252,833	Inc.	$21,193
Exp., taxes, dep.....	183,874	171,738	Inc.	12,136
Net earnings.....	$90,152	$81,095	Inc.	$9,057
Total net	93,602	83,393	Inc.	11,209
Charges	45,173	33,648	Inc.	12,525
Surplus	$48,429	$48,745	Dec.	$316
Gross, three months..	804,560	742,028	Inc.	26,062
Exp., taxes, dep.....	534,677	508,615	Inc.	26,062
Net, 3 months.....	$269,883	$233,413	Inc.	$36,470

The Toledo Railways and Light Company reports for March:

	1906.	1905.	1904.
Gross earnings	$158,285	$146,565	$138,665
Expenses and taxes.....	84,702	75,672	77,858
Net earnings	$73,583	$70,893	$60,807
Charges	42,200	52,863	41,971
Surplus	$31,383	$28,030	$18,836
Gross, three months.....	460,147	430,915	400,220
Expenses and taxes.....	243,016	220,994	223,764
Net earnings	$217,131	$209,921	$176,456
Charges	126,794	128,383	124,873
Cur., 3 mos.....	$90,337	$81,538	$51,583

AMERICAN LIGHT & TRACTION.—The American Light & Traction Company's surplus earnings, after dividend requirements and after deducting $180,099 for reconstruction reserve account, for the quarter ending March 31, 1906, were $129,840, against $105,495 for the corresponding quarter last year. The company's net earnings for the twelve months ending March 31, 1906, increased 47 per cent. Not including the earnings of the Quebec-Jacques Cartier Electric Co., the Lacombe Electric Co., the Muskegon Traction & Light Co., and the Detroit City Gas Co., all of which properties have been acquired by it during the present year, the American Light & Traction Co.'s net earnings for the first quarter in 1906 increased 32 per cent. over those of the first quarter of 1905. At the organization meeting of the company's directors, numerous changes in officers were made, all to take effect May 1. Sheldon J. Glass, now secretary and treasurer, was elected vice-president and general manager of the company's subsidiary company in Milwaukee. Lanson P. Lathrop, now the vice-president and general manager of the Detroit City Gas Co., was elected vice-president and treasurer of the Light & Traction Co. H. L. Doherty, now general manager of the company, was elected a vice-president and consulting engineer. James M. McCarty, now connected with the company's Quebec property, was also elected a vice-president. James Lawrence was elected secretary and Marion McMillin assistant secretary of the company.

PENNSYLVANIA ELECTRIC VEHICLES.—The stockholders of the Pennsylvania Electric Vehicle Company will meet in Camden this week to vote upon the proposal to liquidate the company's affairs. The directors have unanimously approved this step, and it is understood that a majority of both the preferred and common stockholders are in favor of dissolving the company. A conservative estimate is that the preferred stockholders will get about $3.75 a share from a sale of the company's effects. As the preferred stock is entitled to the full par value ($10 a share) in liquidation, before anything goes to the common shares, it is obvious that the latter stock will get nothing when the assets are sold. This has directed the attention to recent heavy purchases of the common stock at ⅛, the significance of which is not understood, unless it is the intention of these purchasers to ask the courts to stop the proposed dissolution. Some of the directors say the common stock has nothing to gain by the company continuing in operation, in view of the small amount of its business, and the possible further depletion of the assets in maintaining its organization for a business not sufficiently profitable to warrant it. They think, therefore, that the best thing for all concerned is to dispose of the assets and close up the business.

LOS ANGELES REFUNDING.—The Los Angeles Edison Electric Company is issuing $1,500,000 of refunding 5 per cent mortgage gold bonds, which will bring the bonded debt up to $8,265,000 out of $10,000,000 issued. The capital stock is $4,000,000 cumulative 5 per cent preferred and the common is $6,000,000, of which is issued $3,840,200 of the preferred and the same amount of common. The gross earnings for the year ending February 28, 1906, were $1,341,684, with operating expenses $549,573 and accrued bond interest of $295,524, leaving a surplus of $496,587. The company has valuable water power rights on the Kern River, 110 miles distant, and will secure 20,000 hp there. Last February the company's connected load was 480,653 incandescent lamps, 1,938 commercial arcs, 552 city arcs, 14,451 hp in motors, and 26,307 connected electric meters. The population served is 275,000. Perry, Coffin & Burr, N. W. Harris & Co. and E. H. Rollins & Sons handle the above offering of bonds.

SUBMARINE SIGNAL STOCK.—It is stated in Boston that the issue of $250,000 new stock by the Submarine Signal Co. at $20 per share is equivalent to a right worth from $4.50 to $5 per share, as the stock has been selling on the curb at about $24.50 per share. The new issue has been underwritten at $25, or par, less a commission of $5 per share, with an agreement between the company and the underwriters that it should be first offered to the stockholders on the same terms. The underwriters are paid no commission except on such stock as they are allotted. The directors who have offered the stockholders an opportunity to take the entire new issue on the same terms as the underwriters are ready to take it, feel they have come as near to paying a dividend by giving a right worth $4 or $5 per share as is wise or safe at this time.

BRUSH ELECTRICAL ENGINEERING.—The dividend announcement of the Brush Electrical Engineering Company, of England, just published, indicates a considerable improvement in the company's position during the past twelve months. A year ago only the preference dividend was paid, but now the ordinary are to get 2½ per cent. for the year, and this is not effected by dividing the profits up to the hilt, as nearly $34,500 is allowed for depreciation and $37,500 is placed to general reserve, each of which appropriations is, in round figures, about $2,500 more than the sums allotted to these items at this time last year. The dividend is certainly encouraging, as it is the first return for the ordinary shareholders since 1900, when they received 5 per cent.

TO DEAL IN PLANTS.—The Continental Public Utilities Company filed with the Secretary of State of Maine recently its certificate of incorporation. The purposes, which are numerous and varied, are mainly to construct, buy and operate gas and electric lighting plants and street and interurban railroads. The company has an authorized capitalization of $12,500,000, of which $10,000,000 is common stock. Milard W. Baldwin, of Portland, is president and clerk.

THE NORFOLK (VA.) MERGER.—The consolidation of all the electrical traction, light and gas properties in Norfolk, Portsmouth, Berkeley and Suffolk, with the exception of the Bay Shore Terminal and Norfolk & Atlantic Terminal properties, into the $14,000,000 holding corporation known as the Norfolk & Portsmouth Traction Company, has been finally completed, and the merger becomes effective from June 1.

GENERAL NEWS.

Construction Notes.

BESSEMER, ALA.—The North Johns Telephone Company, recently organized, has let the contract for the erection of a complete system and work has commenced.

TOMBSTONE, ARIZ.—D. A. Adams, of Dragoon, has been granted permission to erect a telephone line within limits of the town of Benson. He contemplates extending the line to Johnson.

HARRISON, ARK.—J. B. Quigley and J. C. Settle, of St. Louis, Mo., have secured a franchise for an electric light and gas plant and water works.

WYNNE, ARK.—A 120-hp engine and electric alternator will soon be installed in the city lighting and water works plant. E. H. Demsey is superintendent.

TEXARKANA, ARK.—Plans and specifications have been prepared by H. A. Overbeck, Juanita Building, Dallas, Tex., for the erection of a fireproof building for the Southwestern Telegraph & Telephone Company at Texarkana.

LITTLE ROCK, ARK.—The Southwestern Telegraph & Telephone Company will soon commence to put its wires underground in that part of the city in which the company obtained a franchise to lay underground conduits. It is expected that the work will be completed by July.

DE QUEEN, ARK.—The De Queen Light, Ice & Cold Storage Company of De Queen, Ark., has purchased an additional horizontal Reynolds Corliss engine, 19x30 inches, from the Allis-Chalmers Company, of Milwaukee. The new unit will run non-condensing with 100 lbs. steam pressure, and direct connected to a 13x26 ammonia compressor.

EUREKA SPRINGS, ARK.—Matthews & Barnes, who recently obtained an electric franchise for ninety-nine years from the city, purchased the famous Woodruff power site on Kings River, nine miles east of town, and will install large turbine water wheels there, transmitting the power by wire to their proposed plants here. A concrete dam will be put in at a point where the river forms a loop of 8,000 feet, separated only by a bluff 100 feet high and 150 feet across and through which a tunnel will be drifted. Sufficient power can be generated to supply every industry, public and private, in the city.

PASADENA, CAL.—It is reported that the mayor is in favor of issuing bonds to establish a municipal lighting plant.

ESCONDIDO, CAL.—H. T. Duff has secured a franchise for the construction of an electric light plant at a probable cost of $25,000.

SANTA CRUZ, CAL.—The City Light Company will soon install 40 more arc lamps, making a total of 140 lamps owned and operated by the city. R. S. Tait is superintendent.

MARYSVILLE, CAL.—The Northern Electric Company has awarded the contract for the construction of the proposed electric railway from this city to connect with the road already built between Chico and Oroville.

LOS ANGELES, CAL.—The Home Telephone Company is reported to have purchased the Cuaymaca telephone lines, leading from Lakeside to the Stonewall lines in the mountains, and it is reported the company will extend its lines across the desert to Imperial.

REDDING, CAL.—The Shasta Power Company will build its substation on the northeast corner of Pine and Sacramento Streets in Redding. The work of construction on the power-house and pole line will be resumed as soon as the weather conditions will permit. The company's power station is on Snow Creek and the water for power will be taken from Hat Creek.

FRESNO, CAL.—The San Joaquin Power Company's new power plant is almost ready for operation and is now being thoroughly tested. The present plant with four units furnishes but 2,500 hp. The new plant with two hydro-electric units furnishes 3,500 hp in addition. The work of tunneling for the ditches running to Crane Valley, where still more power is to be developed, has been greatly hindered by the recent storms. There is to be in all 4,000 feet of tunnel. Of this amount 800 feet is completed.

SAN FRANCISCO, CAL.—Construction has been begun by the Union Pacific in Wyoming on the new independent telephone system to be established by E. H. Harriman along the lines of the Union Pacific and Southern Pacific from Chicago to San Francisco. James McReynolds, who has just completed the construction of 2,000 miles for the Postal Telegraph Company in Wyoming, will have charge of the work, with headquarters in Cheyenne. This line will be built for the purpose of facilitating the handling of trains. A separate pole line which will be used exclusively for the telephone and block system will be built the entire length of the system. The first division to be constructed will be from Green River to Cheyenne and will be completed this year.

PLACERVILLE, CAL.—H. J. Maxwell, of San Francisco, has recently located two large water rights on streams 35 miles east of Placerville. On one location he claims 6,000 inches of water measured under a 4-inch pressure on the south fork of the American River, in township 11 north, range 16 east. By the second location Maxwell claims 3,000 inches of water measured under a 4-inch pressure of the Silver Fork of the South Fork of the American River. The two water rights are so situated that the waters from both may be brought together and furnish a great fall back to the American River. The water is claimed for the purpose of mining, manufacturing and general electrical power. By his appropriation he will be enabled to use a large quantity of water that will be stored in Echo and Silver Lakes, by other interests, which will flow down the American River, and be used by Maxwell, and turned back in the river without interfering with the use of the water by prior locators.

WINDSOR LOCKS, CONN.—The Windsor Locks Electric Lighting Company has recently installed a new engine and generator in its lighting plant.

NORWALK, CONN.—The Connecticut Railway & Lighting Company has decided to install new arc lamps in the city of Norwalk. The kind of lamp has not yet been decided. A. D. Wainwright is superintendent, to whom communications should be addressed.

YALESVILLE, CONN.—The Electric Light Committee has made arrangements with the electrical commissioners of Wallingford to furnish the town with fifty 32-cp incandescent lamps to be in operation by August 1.

EAST HADDAM, CONN.—East Haddam Electric Light Company contemplates raising the present dam from 14 feet to 72 feet the coming summer, which means an entirely new plant. E. W. Crocker is superintendent.

BRIDGEPORT, CONN.—The United Illuminating Company contemplates building an addition to the electric light station on Congress Street. It will be a brick building two stories high, and will cost about $8,000. Warren R. Briggs is the architect.

WALLINGFORD, CONN.—At a recent borough meeting the citizens voted to enlarge the municipal electric lighting system by utilizing the water privileges on the Quinnipiac River, which were purchased last June; installing a water wheel, generators and other appliances necessary and constructing a transmission line to the present lighting station. The cost is not to exceed $5,500.

WILMINGTON, DEL.—The Wilmington City Railway Company has placed contracts for new equipments, which will cost about $400,000. Work will be started as soon as possible.

WILMINGTON, DEL.—It is reported that work will soon begin on the addition to the Delaware & Atlantic Telegraph & Telephone Company's building at Sixth and Shipley Streets.

WILMINGTON, DEL.—Ground has been broken for the proposed electric plant of the Wilmington Light, Power & Telephone Company, on the site purchased on the north side of the Brandywine. The engine and boiler rooms will be 90 by 62 feet. The new buildings will run up to the end of the present wharf and it will be necessary to build a coffer dam about fifteen feet out from the wharf. It is expected that the plant will be finished some time next fall. The A. S. Reed & Bro. Company has the contract to put up the buildings.

WASHINGTON, D. C.—Bids will be received until May 8 at the Bureau Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the Navy Yards, at Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C., and Norfolk, Va., a quantity of naval supplies as follows: Schedule 518—Incandescent lamps, electrical supplies, bar steel, strip brass, etc. Schedule 519—Motor, electric motor equipment for launch, sheet copper, bar steel, cast steel block, copper iron pipe, etc. Applications for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster-General, U. S. N.

LAKE CITY, FLA.—The Lake City Water & Light Company writes that it will soon move its plant and install new machinery and make improvements in general. Frank A. Farwell is superintendent.

TALLAPOOSA, GA.—The city is now constructing a new electric lighting plant which will cost $13,000. A. J. Radcliff has charge of the work.

COLUMBUS, GA.—The Columbus Power Company is contemplating the construction of a new power plant, and has purchased the site for the same.

CORDELE, GA.—The Citizens' Electric Light & Power Company has purchased a 350-hp Corliss engine, a 150-hp boiler and a 115-kw generator with switchboards, which are to be added to the present plant of the company in this city.

GRANGEVILLE, IDAHO.—The City Council has granted the Nez Perce Telephone Company a twenty-five year franchise to extend its line here from Cottonwood, and also to start an exchange. The line is expected to be built and in working order within three months.

GILBERTS, ILL.—The Elgin & Belvidere Railway Company will build a power plant in this place.

CHICAGO, ILL.—The North Shore Electric Company will increase its capital stock from $750,000 to $2,000,000.

HAMPSHIRE, ILL.—The lighting commission has decided to install meters in the village lighting system and abolish the flat rate system.

QUINCY, ILL.—The Quincy Gas, Electric & Heating Company is considering the extension and improvement of its plant. W. A. Bixby is manager.

CORNELL, ILL.—M. J. Rhodes, proprietor of the Cornell electric light plant, contemplates installing machinery for a day load during the coming season.

CAIRO, ILL.—It is stated that the Central Union Telephone Company contemplates making extensive improvements on its local equipment which will cost $8,000.

LAWRENCEVILLE, ILL.—Charles G. Arnold, superintendent of the Lawrenceville Light & Water Company, writes that the entire system is being overhauled and rebuilt.

MATTOON, ILL.—The city electric light plant, under the management of H. W. Clark, has just completed the change of equipment in its plant. H. A. Schrock is superintendent.

ALTON, ILL.—The Village Council of North Alton has granted a franchise to the Alton, Jacksonville & Peoria Traction Company, giving the company the use of the main street of the village.

AURORA, ILL.—It is stated that the contract for the installation of the new electric lighting plant for the city has been awarded to the Ball Engine Company and the Western Electric Company.

FREEPORT, ILL.—The Freeport Railway, Light & Power Company is considering the extensions of its street railway lines and building a water power plant six miles from the city. Charles Baumgarten is superintendent of the light and power department.

WAUKEGAN, ILL.—The Chicago Telephone Company is considering the question of putting the toll lines between Chicago and Milwaukee in underground conduits to insure more reliable service. Permission to change from poles to conduits will be asked of the cities and counties along the route.

BELLEVILLE, ILL.—The Belleville Gas & Electric Company is now installing a 750-hp Reynolds direct-connected Corliss engine in its plant, the unit being furnished by the Allis-Chalmers Company. This with other improvements will entail an expenditure of $40,000. Harry P. Kucher is manager.

VEVAY, IND.—The matter of adding another dynamo and engine to the municipal electric light and water works plant is now under consideration. Charles Allen is engineer.

WABASH, IND.—The Home Telephone Company of this city, is arranging to erect a new business block for its own use, and to install a 10,000 central-energy multiple-switchboard.

WESTVILLE, IND.—The Town Council of Westville has granted a thirty-year telephone franchise to E. S. Smith, E. T. Scott, O. W. Weed and Jacob Harold, of this place, and James H. McGill, of Valparaiso, Ind.

WOLCOTT, IND.—The Wolcott Electric Light Company writes that the company will put in a water works system in this town, and is considering the question of extending its lines to Remington, a distance of 6 miles. W. S. Lewis is manager.

MARION, IND.—O. L. Barger, who has an option on a franchise for the installation of an automatic telephone system in Marion, has stated that he has placed $125,000 of the stock of the new company that is to be organized and that he expects to be able to place the other $25,000.

LINTON, IND.—The City Council has sold the Linton electric light plant to the local gas company for $32,000; the company to give the grounds and building to the city. The company agrees to furnish street lamps at $50 a year. It is understood the plant will be practically rebuilt.

EVANSVILLE, IND.—Henry W. Marshall, Charles Murdock and Samuel T. Murdock, of Lafayette, have secured a controlling interest in the Evansville Electric Company. In the reorganization Charles Murdock succeeds James O. Parker as president, and Henry Marshall becomes secretary-treasurer, vice Judge Alexander Gilchrist. Herbert Moran is retained as vice-president and general manager. The new directory includes the four new persons named, with the addition of Thomas Krutz, of New York, and William G. Krutz, of Chicago.

ARDMORE, I. T.—The Chickasaw Telephone Company is preparing plans for a new central energy exchange, fully equipped with new switchboard and telephones.

SAPULPA, I. T.—The Central Light & Fuel Company of this place has been sold to the Deming Investment Company, of Oswego, Kan. Mr. Deming owns the natural gas plants of Parsons, Baldwin and Weir City, Kan., and at Chelsea and Coweta, I. T.

CHICKASHA, I. T.—The Chickasha Light, Heat & Power Company contemplates making important changes and improvements in its plant. The company will install a 4,000-light unit and rebuild the entire overhead system. A. B. Coryell is manager.

DURANT, I. T.—The Pioneer Telephone & Telegraph Company is installing a complete metallic circuit in this city, capable of handling 1,500 subscribers. The cable is being strung over all sections of the city and the system will be in operation in about forty days.

CHEROKEE, IA.—The local telephone company is extending its lines to Afton and Spring.

NEVADA, IA.—The Nevada Electric Company expects to install one 25-hp alternating-current motor and one 5-hp alternating-current motor for pumping purposes. M. A. Harrison is superintendent.

TOPEKA, KAN.—The Missouri & Kansas Telephone Company is considering the erection of an addition to its building, to cost $3,900.

ABILINE, KAN.—The Riverside Light & Power Company is now installing a 200-kw Stanley alternator and will soon start day service for power.

SALINA, KAN.—It is reported that the Salina Telephone Company will soon begin putting its wires underground. The company will spend about $50,000 in improvements this year.

TOPEKA, KAN.—The Independent Telephone Company has increased its capital stock from $150,000 to $1,000,000. The company will spend about $400,000 in improving its system in this city. The company will place all its wires under ground and also erect a new office building. B. F. Pankey is president and general manager.

BELLEVILLE, KAN.—Bids will be received until May 15 at the office of J. B. Peach, city clerk, for furnishing material and supplies necessary for equipping and installing a complete electric lighting system for this city, and for making certain improvements in the water works, to consist of the following: Brick power house; steel stack; one 66-ft. x 16-in. tubular boiler; two high-speed engines for direct connection to alternators; steam piping, valves and covering; steam specialties; two 75-kw alternating-current generators and exciters with switchboard; pole line material, arc apparatus, transformers, station wiring, etc. W. K. Palmer is consulting engineer, 718 Dwight Building, Kansas City, Mo.

OLYMPIA SPRINGS, KY.—Smith, Watkins & Company are contemplating installing an electric light plant in this city.

LOUISVILLE, KY.—It is stated that the East Tennessee Telephone Company will soon improve its system by substituting individual lines for party lines. The company also contemplates extending its lines into Clark County.

LOUISVILLE, KY.—The Board of Aldermen on April 17 adopted the ordinance requiring companies using electricity in the central portion of the city to place their wires underground, beginning five months from passage of ordinance.

MINDEN, LA.—The Minden Electric Light and Power Company, Ltd., recently installed a new Corliss engine to replace the old one of other make. Louis Arnard is chief engineer.

SOUTH PARIS, ME.—The citizens of this village will soon hold a meeting to decide whether the village will have a plant of its own for lighting the streets and public buildings. This is the outgrowth of the contest with the Oxford Light Company, of Norway, which resulted in the act passed by the last Legislature allowing the town corporation to do its own heating and lighting.

MILFORD, ME.—The concrete dam which is being constructed between Oldtown and Milford by the Milford Construction Company, is nearing completion. Excavations are now being made at the Milford end of the dam for a power-house 224 feet in length and 80 feet wide. Twelve 800-hp wheels will be installed. The Allis-Chalmers Company will furnish the water wheels and the generators will come from the Stanley Electric Company. The Union Iron Works of Bangor has the contract for the structural steel and the castings. Electrical power will be generated at this plant for distribution to manufacturing establishments along the river for the distance of twenty miles.

BANGOR, ME.—The Maine & New Brunswick Electrical Power Company, Ltd., has commenced an electrical power plant at the great falls on the Aroostook River just across the line from Fort Fairfield, Me. The plan also includes the construction of a concrete dam 32 feet high and the development of estimated 3,000 hp. It is intended to generate electrically the power in four units of 750 hp each, and 1,500 hp will be developed as soon as the plant is in operation. The electricity will be transmitted to all parts of Aroostook County for lighting and power purposes, and also to places in New Brunswick, the company being chartered both in Maine and New Brunswick. The company already has a contract to transmit to Houlton, a distance of 60 miles, 250 horse-power for 15 years. The company has been incorporated with a capital stock of $250,000.

BALTIMORE, MD.—It is reported here that the charter of the Baltimore & Ocean City Railroad Company, which was granted at the recent session of the Legislature, will be used for a monorail line between this place and Ocean City, Md. The American Monorail Company, in which a number of Pennsylvania capitalists are interested, owns the charter and proposes to build the road.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company will construct a new electric light plant at Westport, Md.

BETTERTON, MD.—The Betterton Improvement Association will receive bids for installing a lighting plant for the town. The proposition must include part ownership.

MARLBORO, MASS.—The trustees of the municipal light plant are contemplating the extension of the lighting system to the town of Stow.

MILFORD, MASS.—At a recent meeting of the board the Selectmen voted to contract with the Milford Electric Light & Power Company for 58 arc lights for one year at $5,000 and with the Globe Gaslight Company for 75 boulevard gasoline lamps to burn all night, twenty-five nights a month, at $1,800.

MIDDLETON, MASS.—The electric light committee is making investigations in regard to the actual expenses of installing electricity in the town, in order to make a more definite report at the next meeting. At the last meeting the committee was unable to recommend a sum of money the town would be required to appropriate to carry out the proposed plan.

PITTSFIELD, MASS.—The Pittsfield Electric Company, which recently bought a large tract of land on the north shore of Silver Lake, plans to expend about $50,000 for new buildings and machinery. A power-house, 80 by 100 feet, is to be erected, also a boiler-house, 50 by 100 feet. A spur track will extend from the Boston and Albany railroad to the latter building, where coal pockets will be built. The electrical equipment will include a 50-kw alternating-current Stanley generator. Two Deisel oil engines of 500-hp are also to be installed.

HOUGHTON, MICH.—The Keeweenaw Copper Company has decided to develop the water power of Mosquito Lake.

ONTONAGON, MICH.—The Lane & Bodley Company, of Cincinnati, Ohio, has secured the contract for the new electric lighting plant in this village.

WHITEHALL, MICH.—The village is contemplating installing a series alternating arc system in the municipal electric light plant. W. E. Pierce is superintendent.

DURAND, MICH.—Fred L. Eldridge, village clerk, writes that the village expects to install a new boiler of 150 hp in the municipal electric lighting and water works plant.

OWOSSO, MICH.—Permission has been granted to the Owosso & Corunna Street Railway Company to extend its franchise, and work on the road will be extended to Durand at once.

OXFORD, MICH.—A. H. Betwee, superintendent of the city water and lighting plant, writes that a 60-kw Westinghouse alternator, an engine and new switchboard, are now being installed.

BERRIEN SPRINGS, MICH.—The Berrien Springs Power & Electric Company has been formed to construct a dam on the St. Joseph River at Berrien Springs. The dam will be 21 feet long and will cost with the electric light plant complete about $1,000,000.

SHEPARD, MICH.—C. C. Fields, of this place, has secured options on the land along the Chippewa River, and will construct a power plant to supply power in the counties of Isabella, Gratiot, Midland and Clare. The capital necessary for the construction of the dam, power houses, etc., is ready.

DETROIT, MICH.—The Michigan State Telephone Company is putting 100 miles of wire under ground, building two new exchanges, one in the extreme west portion and one in the extreme east portion of the city. It will also build a six-story building adjoining the present head office, to cost $160,000.

COLDWATER, MICH.—It is reported that the Battle Creek & Coldwater Electric Railway Company has purchased all its right of way and that rails will be laid this summer. The road will be operated by the third rail system, and will run from Battle Creek through Athens and Union City to Coldwater, a distance of 37 miles.

SWARTZ CREEK, MICH.—It is reported that the newly organized telephone company, which is formed of business men and farmers of this place, has commenced setting poles for the system. The new company will erect the building and the Bell Telephone Company will equip the exchange. It is expected to have the line in operation soon.

NORTON, MICH.—Preliminary steps toward forming a company to build a rural telephone line in Norton township were taken at a meeting held recently. Officers were elected as follows: William H. Patton, president; L. R. Coston, secretary; Edward Seng, treasurer. Plans for the proposed line have already been prepared and have been submitted to the Citizens Telephone Company of this city for consideration.

GRAND RAPIDS, MICH.—Negotiations are now under way for the promotion of an electric railway from Grand Rapids to Battle Creek via Hastings and Alaska, a distance of about 50 miles. Mr. Jackson, of Madison, Wis., will probably have charge of the electrical construction of the road. J. J. McVean, consulting engineer, of this city, will have charge of the preliminary survey. A. C. Sekeel and John E. More are also interested.

MUSKEGON, MICH.—Press reports states that the Grand Rapids-Muskegon Water Power Electric Company has awarded the contract for the construction of a second dam and water electric plant at Croton with a capacity of 12,000 hp. The work is to be completed before freezing weather next fall. To convey the current from this dam to the switch station near Casnovia village a new pole line 30 miles long will be built. The poles will carry three wires, the same as the present line.

GRAND RAPIDS, MICH.—John McNabb has received the contract for the addition to the main exchange of the Michigan State Telephone Company, and work will begin at once. The addition will be a two-story building similar to the present exchange adjoining it on the east. On the second floor will be installed the long-distance exchange and the present equipment will be doubled, over 200 connections being accommodated on the new board. The approximate cost of the improvements is $12,000.

GRAND RAPIDS, MICH.—The new water power electric company on the Big Manistee River, which is under the direction of M. B. Wheeler and R. A. Opdyke of this city, is assuming proportions that excel any of the similar plans in the State. It is understood that a good share of the $2,000,000 capital stock has been subscribed by Chicago capitalists and that part of the material for the construction of the big dam is already on the grounds. The dam will be located on the Manistee River in Wexford County, and two miles west of Sherman. It is estimated that 50,000 hp can be developed.

SEDAN, MINN.—The Sedan Telephone Company will soon start work on its lines.

TENSTRIKE, MINN.—The citizens have voted to issue bonds for the construction of a lighting system.

McINTOSH, MINN.—Anton Jensen, proprietor of the McIntosh electric light plant, will soon install a 70-hp gas engine.

STAPLES, MINN.—It is reported that the town will receive propositions for an electric light plant. J. D. Marlin is recorder.

HASTINGS, MINN.—The citizens have voted to issue $50,000 bonds for the construction of water works and an electric light plant. H. M. Durris is city clerk.

STAPLES, MINN.—The Staples Electric Company has purchased the plant of the Northern Electric Company and will rebuild it this season. E. Rohan is lessee and manager.

SHAKOPEE, MINN.—A. K. Adams, superintendent of the Shakopee electric light plant, writes that the city is considering adding 15 or 20 new series arc lamps to the street lighting system.

DULUTH, MINN.—It is reported that the Duluth Telephone Company will expend $100,000 in extending and improving the service in the two cities and the Range towns and installing better facilities for the long-distance business.

LA VERNE, MINN.—The street lighting system of the La Verne electric light and water works will be changed this season. A 60-kw Thomson-Houston alternator will be installed in place of the series arc machine now in use. The style of lamp has not yet been determined. L. J. Philbrick is chief engineer.

OSAKIS, MINN.—The farmers and business men of Nelson, Douglas County, have organized a company to build a telephone exchange at Nelson and build farmers' lines into the surrounding country. Connection will probably be made with the Leslie Rural Telephone Company. The company will be capitalized at $10,000. The company will incorporate under the name of the Bolson Telephone Company. The following officers have been elected: John Nelson, president; Charles Schelin, vice-president; H. J. Ernster, secretary; N. O. Johnson, treasurer.

UNIVERSITY, MISS.—The University electric light plant, of which E. Campbell is superintendent, is considering the installation of some new machinery the coming season.

IUKA, MISS.—The city electric lighting plant has recently installed larger mains and arc lamps and also expects to change its system from direct current to alternating current soon. J. E. Marshall is general manager.

BAY ST. LOUIS, MISS.—The Bay St. Louis Ice, Light and Bottling Works will install a 60 or 75-kw, 60-cycle, single-phase, belted generator in the near future, also a 125-hp high-speed engine. A. L. Stokoe is proprietor.

ABERDEEN, MISS.—The city of Aberdeen purchased the lighting plant of the local company about one year ago, and has recently built and equipped a new plant in connection with the new water works system. The electrical outfit is 60-cycle, three-phase with 50 series alternating-current arc lights on streets. John A. Walker is superintendent.

NEW MADRID, MO.—The electric light plant owned by H. B. Day was recently destroyed by fire, causing a loss of $5,500.

BLOOMFIELD, MO.—Bloomfield Electric Light, Heat & Power Company will install a 100-hp engine and a steam heating and water works system this spring.

MILAN, MO.—The Milan Electric Light Company is on the market for enclosed street arc lamps and transformers. E. S. Bennett is superintendent of the plant.

ST. CHARLES, MO.—The city of St. Charles contemplates combining the electric light plant with its water plant, which will necessitate larger boilers, etc. Charles H. Kansteiner is city clerk.

BELTON, MO.—A company has been formed and chartered with a capital stock of $200,000 to construct an electric or gasoline motor road from Kansas City to Belton, a distance of 20 miles. G. W. Scott and H. W. Mastin, of Belton, are among those interested in the project.

ST. LOUIS, MO.—The St. Louis & Suburban Railway Company has bought the franchise authorizing the Connecting Railway Company to build an electric railway in St. Louis County from the Florissant Division of the Suburban Railway on the north to the St. Louis & Meramec Railway on the south.

ST. LOUIS, MO.—The United Railways Company has filed a petition with the county court asking permission to erect poles for electric wires along the Fee Fee road, between the St. Charles and Creve Cœur Lake electric railways, which are a part of the United Railway system. It is reported that a new electric power station will be built on the Fee Fee road to furnish power for the two car lines.

ANACONDA, MONT.—It is reported that the Bell Telephone Company is preparing for the rebuilding of its lines in this city and the establishment of a new exchange.

LIVINGSTON, MONT.—The Livingston Water Power Company has just installed a new 750-kw General Electric, 3-phase, 2,300-volt, 60-cycle alternator, direct connected to a 1,325-hp Leffel water wheel. The company is going to rebuild its entire system and put in day service. J. L. Bright is manager.

WAKEFIELD, NEB.—The citizens have voted to issue bonds for the construction of an electric light plant.

NEBRASKA CITY, NEB.—The Nebraska City Telephone Company will spend about $25,000 in improving the local toll connections.

TECUMSEH, NEB.—The city will soon take action on rebuilding the city electric light plant or granting a franchise, as the present plant will not supply the demand. The plant is to be changed from direct to alternating current. Frank B. Thurber is electrician.

ASHLAND, NEB.—The Ashland Light, Mill & Power Company has rebuilt its lines through the town and is now putting in meters, and it contemplates extensive improvements in its dam during the summer. The company has a steam plant which is run in connection with its water power. The water power will develop 125 hp under ordinary conditions and the steam 100 hp. F. E. Miete is superintendent.

VIRGINIA, NEV.—Sam Longabaugh has incorporated a company to supply Reno, Sparks, Virginia and Carson with electricity. The generating plant will be built south of Slide Mountain.

WESTVILLE, N. J.—Plans have been made for the new power house to be built in this city for the new electric railway of the West Jersey & Seashore Railroad. Stern & Silverman are the architects and engineers.

LONG BRANCH, N. J.—The telegraph, telephone and electric light companies have agreed to remove all of their poles and bury all of their wires in front of the Ocean Park block on Ocean Avenue. The 100-foot plaza in front of the park has already been graded and the westerly curb line laid.

SOCORRO, N. M.—E. M. Burgess, of Denver, general superintendent of the Colorado Telephone Company, and J. E. Elder, local manager at Albuquerque, are contemplating the extension of its line from Socorro to San Marcial in the near future.

BERNALILLO, N. M.—E. M. Burgess, general manager of the Colorado Telephone Company, was in town recently on a tour of inspection. The company contemplates putting in an exchange at Corrales and to connect it with the Bernalillo switchboard.

ALBUQUERQUE, N. M.—The Colorado Telephone Company has let the contract for construction of its fireproof, three-story building to H. V. Tegner. The building will cost $20,000. J. L. Bell Company has contract for the plumbing and Nash Electric Company the electric wiring and fitting.

ALBION, N. Y.—The Bell Telephone will spend $28,000 in putting its wires under ground in this city.

GREEN ISLAND, N. Y.—The Hudson River Telephone Company will ask for permission to place its wires under ground in this village.

WATERTOWN, N. Y.—The City Council has awarded the contract to the Watertown Electric Light Company for lighting the public streets for a term of five years.

PHELPS, N. Y.—The local telephone company, with its lines and business, has been sold by Great Brothers to the Inter Ocean Company, which will rebuild the lines.

COHOES, N. Y.—The Council has granted the Hudson River Electric Power Company permission to extend its system into Cohoes and sell electricity. Bryce E. Morrow, of Glen Falls, is manager.

BINGHAMTON, N. Y.—Plans are being made by the New York State Telephone Company to begin the construction of the Henry and Wall Street subway, and it is expected to have the work completed by June.

NEW YORK, N. Y.—The New York, Westchester & Boston Railway Company is preparing plans for a power plant to be erected in Westchester County at a cost of $500,000. Wilson & Butler are architects.

ALBANY, N. Y.—An ordinance has been passed by Council, providing for the placing of all telegraph, telephone and electric wires underground, and in conduits, with the exception of the wires used by the electric car lines.

NEW YORK, N. Y.—Bids will be received until May 3 by Francis J. Lantry, commissioner of correction, for furnishing material and installing a new underground system of feeders for supplying electric lights to the various buildings and chapels, etc.; also furnishing and erecting outside lights to entrances to buildings on Hart's Island, New York.

UTICA, N. Y.—The John F. Hughes Constructing Company, has secured the contract for the construction and equipment of four sub-stations to be built along the West Shore Railroad between Utica and Syracuse for use of the Mohawk Valley Company in the electrification of the West Shore Railroad from Utica to Syracuse, the substations to cost about $25,000 each. The Archbold-Brady Company has secured the contract for stringing the high-tension wires between Clark Mills and Manlius Center, for about $100,000.

GLENS FALLS, N. Y.—Piles have been delivered at the plant of the Hudson River Electric Power Company for use in constructing a foundation for the proposed high-tension building on which work will soon be started. This building will accommodate wires extending from the Spier Falls plant on the upper Hudson, and the apparatus that will be required in connection with them. The power company recently shipped back to the General Electric Works, Schenectady, a 500-kw machine that has been used in generating power since last June. A 1,000-kw machine is ready for permanent installation.

BUFFALO, N. Y.—The Aldermen have unanimously adopted the report of the joint council committee in favor of contracting with the Buffalo General Electric Company for supplying electric street lamps for the city for five years. The Buffalo General Electric Company has agreed to furnish electric arc lamps to the city for five years from March 1, 1907, for $56 a lamp per year instead of $75, the present price. The city is also to have the benefit of the $56 rate for the remaining nine months of the present contract, commencing June 1, 1906. The saving in the new five years' contract figured from $75 will amount to $269,135, or $53,827 per year. The saving for the five years and nine months will be $309,500. The company also agreed to reduce the maximum price of electric lights to private consumers from 12 cents per kw-hour to 9 cents per kw-hour.

MARIETTA, OHIO.—The county commissioners have decided to install an electric light plant for the court house.

OBERLIN, OHIO.—The Oberlin Gas & Electric Company has placed contracts for new equipment which will about double the capacity of its lighting plant.

MASSILLON, OHIO.—The Massillon Light, Heat & Power Company is stringing several lines from Massillon to Canal Fulton and will supply that town with light.

MARIETTA, OHIO.—The Board of Public Works has authorized the purchase of an additional generator for the municipal electric lighting plant. C. Hancock is manager.

SPRINGFIELD, OHIO.—The Springfield Emery Wheel Company is erecting a large addition to its plant and will install a 150-hp boiler, a 100-hp engine and a 75-kw generator.

LAKEWOOD, OHIO.—The village council committee has reported favorably on a proposition to issue $25,000 worth of bonds for the purpose of enlarging the village municipal lighting plant.

HUDSON, OHIO.—Citizens of Hudson will hold an election in the near future to vote on the proposition of bonding the village for $10,000 for the purpose of building a municipal lighting station.

CLEVELAND, OHIO.—The Cleveland Light & Power Company has applied for a general franchise in Cleveland. Heretofore the company has done business in a certain part of the downtown section of the city.

CINCINNATI, OHIO.—The Globe-Wernicke Company is having plans prepared for a large power plant in its manufacturing plant near Norwood, Ohio, with a view of driving all of the machinery by electric motors.

TOLEDO, OHIO.—The Toledo Shipbuilding Company will shortly place contracts for the steam and electrical equipment for a large power station. All machinery in the new plant and the dry dock pumps will be electrically operated.

CLEVELAND, OHIO.—It is reported that the Cleveland Electric Illuminating Company will erect a large addition to the power house on Canal Street, which will cost $50,000. The general contract has been awarded to John Gill & Sons.

CANTON, OHIO.—The Canton Light, Heat & Power Company, which recently secured a new 10-year contract to light the city, will install 95 additional arc lamps in various parts of the city, in accordance with the terms of the new contract.

CINCINNATI, OHIO.—The Proctor & Gamble Company, of Cincinnati, is preparing to erect an enormous plant on Long Island Sound. Elzner & Anderson, of Cincinnati, are preparing plans for the plant. A large power station will be included.

LORAIN, OHIO.—The Cleveland & Southwestern Traction Company will start work immediately on the construction of a four-mile belt line in Lorain, for which a franchise was granted last week. The company is also endeavoring to secure a franchise for a line through South Lorain.

STEUBENVILLE, OHIO.—The Steubenville & Pleasant Heights Railway Company has agreed to build an extension through the district known as the Hill Tops on Wilkins Street and Wellesley Avenue. The company will also receive a new grant for 25 years on the older portion of the line.

SANDUSKY, OHIO.—The Sandusky Telephone Company, which is now controlled by the Barber and Brailey syndicate, of Toledo, recently voted to increase its capital stock from $75,000 to $200,000. The company now has about 1,000 telephones and it is the intention to install apparatus that will enable it to double its capacity.

TOLEDO, OHIO.—Contracts have been made for a power plant to be installed in the new Ohio building at Toledo, Ohio. The Toledo Boiler Company will furnish three 150-hp boilers, the Watertown Engine Company of Watertown, N. Y., will furnish three engines, while three generators will be furnished by the General Electric Company.

WARRENSVILLE, OHIO.—Bids will be received until May 1 by the Board of Public Service, Cleveland, for an engine, generator and appurtenances for a lighting and power plant at the transfer station of the Cleveland Farm Colony at Warrensville. A. R. Callon, of Cleveland, is secretary.

TOLEDO, OHIO.—The Toledo, Port Clinton & Lakeside Railway Company, with general offices in this city, is negotiating for the purchase of small lighting plants at Marblehead, Port Clinton, Oak Harbor and Lakeside. The company passes through these towns and desires to secure the lighting business to help out the load of its large power station recently erected at Port Clinton.

NORWOOD, OHIO.—The city will install immediately two new wells and will contract for an air compressor, double-duty type, for the municipal electric lighting and water works system. It will also install additional feeders and one more electrical and steam unit as soon as funds are available. The city expects to spend about $20,000 for improvements to the plant this year. Albert Richards is chief electrician.

CINCINNATI, OHIO.—The Commissioners of Water Works of Cincinnati are advertising for bids on two motor-driven centrifugal pumps of 1,000 gallons capacity, and two direct-connected electric generating units of 75-kw capacity. Bids will be received until April 27. Specifications

are on file with the chief engineer of the Board of Trustees of the Commissioners of Water Works. Elmer G. Prior is clerk.

SPRINGFIELD, OHIO.—Negotiations are on for the consolidation of the People's Light, Heat & Power Company and the Home Light, Heat & Power Company, operating competing systems in this place. The plan is to use the Home Company's plant for heating and lighting the business section of the city while the People's plant will take care of the street lamps and furnish power and lamps for the residence districts and hot water in the outlying section.

OKLAHOMA CITY, OKLA.—The Oklahoma City Railway Company will construct a new line within the next ten months at a probable cost of $200,000.

PERRY, OKLA.—The citizens will hold an election on May 8 to vote on the question of issuing bonds for $30,000 to repair the municipal electric lighting plant. F. F. Busch is city clerk.

OKLAHOMA CITY, OKLA.—The directors of the Gas & Electric Company have decided to spend $125,000 in improvements at the plant, in the way of buildings and new equipment. F. H. Tidman is manager.

ANADARKO, OKLA.—W. T. Croslen, of Shreveport, La., vice-president of the Washitu Valley Interurban Electric Railroad, is reported to be interested in the development of water power on the Pennington, Blue and Washitu Rivers in Chickasaw Indian Nation, and will establish water power stations along the line of its proposed road from Shreveport, La., to Anadarko, Okla. It is estimated that about 50,000 hp will be developed.

ELK CITY, OKLA.—The town of Elk City will receive bids until May 11 for material and the construction of a water works system. There will be required two triplex vertical power pumps of one-half million gallons capacity each, two direct-current electric motors, pipe hydrants, valves, one 60,000-gallon steel water tank and tower. Also one or more 8-in. tubular walls and a small brick building. Bids will be received in each item and on the works as a whole. Address M. A. Earl & Company, Consulting Engineer, Muskogee, I. T., or Chicago, Ill.

ONTARIO, ORE.—The Ontario Light and Water Company has recently been organized to build a water works system and to absorb the present Ontario Electric Light Company.

BAKER CITY, ORE.—The Baker Light & Power Company has added 16 miles of 22,500-volt transmission line to its system and two 350-hp Cahall water tube boilers to its steam plant in Baker City. The company operates a hydro-electric plant of 800-kw capacity and steam plant of 400-kw capacity, 50 miles of transmission lines at 22,500-volt and has four substations. F. N. Averill is superintendent.

PORTLAND, ORE.—The Interior Development Company has let contracts for building what will be one of the largest power development plants in the State on the Deschutes River, near Shear Bridge, about 30 miles south from The Dalles. The company contemplates the development of 50,000 hp for the generation of electricity, and will spend about $200,000. A. Welch, of this city, is president of the Interior Development Company, which was incorporated recently, and E. P. McCornack, of Salem, is secretary. Mr. Welch has just returned from the site of the proposed power plant, and says that the contract for all work has been awarded to Van Dyne & Brown, of the Tygh Valley Company, and a force of men has already begun building bunkhouses and tool sheds, preparatory to starting the construction of the dam across the Deschutes.

PORTLAND, ORE.—The St. Helens Public Service Company is being promoted by Dr. Henry W. Coe, of Portland, Ore., and associates, to construct a standard gauge electric railway from Portland to Vancouver, Wash., in the form of a loop, known locally as the St. Helens Loop. The road when completed will be about 200 miles long. Cowlitz and Clark Counties have granted 50-year franchises for the use of about 200 miles of county roads. Castle Rock, Kalso, Kalama and Vancouver have granted franchises within their limits. All franchises are for 50 years with no restrictions as to when the work must begin. Franchises also cover for all public services, water, gas, telephone and telegraph, electricity, poles and conduits. About 200 miles of surveys have been completed. Thirty miles of private right-of-way have been secured. George W. Lilly, of Portland, Ore., is chief engineer. Kelsey & Young, of Salt Lake City, Utah, have been appointed consulting engineers and will come at once to Portland and take up the work in connection with the road.

GRANTS PASS, ORE.—Two carloads of machinery have arrived here for the Golden Drift Mining Company, consisting of equipment to be added to the big power and hydraulic mining plant of this company in the Dry Diggings, near Grants Pass. Ten more turbines and two additional pumps will be placed. The pump now employed has a capacity of 13,000,000 gallons daily, or 9,000 gallons per minute, delivered through two three-inch monitors under a pressure of 140 pounds to the square inch. This is said to be the largest high-pressure pump ever manufactured. The two pumps that will be added are of the same type as that now employed, but will have a slightly less capacity. The combined capacity of the three pumps will be close to 40,000,000 gallons daily. A portion of this will be lifted into ditches and used for irrigating purposes. Besides the installation of the turbines and pumps, the tailrace will be widened and deepened, and for this purpose a large dredge is being built by the company. Another line of 22-inch steel pipe will be built from the power dam to the diggings to convey the water from the pumps. The pumps are of the five-step centrifugal type, and weigh 35 tons each. 1,200 hp is required to operate each one. The dam develops a total of 6,000 hp.

DURYEA, PA.—It is reported that the business men in this city are making preparations to install an electric lighting plant for commercial purposes.

PHILADELPHIA, PA.—Plans have been made for alterations and repairs to the power and engine house of the University of Pennsylvania. Cope & Stewardson are architects.

SHARPSBURG, PA.—Bids will be received until May 4, by A. H. F. Black, borough clerk, for one 200-kw alternating-current generator, one 300-hp engine and connections.

MANHEIM, PA.—The electric lighting plants of the Lancaster Valley Electric Company at Manheim and Mt. Joy have been purchased by C. T. Leland and Dr. Henry U. H. Stoever, of Philadelphia, Pa. The plants were sold by the Commonwealth Trust Company, of Harrisburg, trustee for the bondholders of the Conestoga Valley Electric Light Company. The indebtedness on the properties amounted to $53,400. The price paid for the two plants was $20,800.

CHESTER, PA.—The Philadelphia Suburban Heat, Light & Power Company, which was recently incorporated and which purchased the Lansdowne Electric Light Company, is about to extend its lines all over the county. It is reported that this corporation has purchased the Faraday Heat, Light & Power Company, of Morton, which has been in existence for many years, supplying light for the boroughs of Morton, Rutledge and Swarthmore. The company was recently granted a franchise by Darby Borough Council to furnish light and power in that borough. It is also said that a large plant will be built in Darby and that the plant in Lansdowne will be discontinued when the new plant is finished.

OLNEYVILLE, R. I.—Work will soon be started on the new telephone building in this city. A large force of men are now laying the underground wires from the main line at Westminster and Howard Streets to the site for the new building.

ABERDEEN, S. D.—Bids will be received until April 30 for the construction of a municipal electric light plant. F. W. Raymond is city auditor.

JACKSON, TENN.—The Louisville syndicate of the Columbia Finance & Trust Company has purchased the Jackson street railroad and electric light plant at a cost of $115,000.

MARTIN, TENN.—At a recent meeting of the Weakley County Telephone Company, of this city, it was decided to increase the capital stock $6,500 and improve the plant, putting in cables and up-to-date fixtures.

MEMPHIS, TENN.—It is stated that the Memphis Consolidated Gas & Electric Company will expend about $150,000 in improvements in the electric generating department of its plant. An Allis-Chalmers turbo-generating set of 1,500 kw capacity will be installed. Work will begin soon on the foundations for additional boiler rooms and coal sheds adjacent to the present plant, and it is expected that the new system will be in operation by next August.

TEMPLE, TEX.—The Southwestern Telephone Company contemplates the expenditure of nearly $20,000 in modernizing and otherwise improving its plant in this city.

NEW BRAUNFELS, TEX.—The Landa Electric Light & Power Company is making extensive improvements to its power plant by the addition of three large dynamos and a switchboard of seven panels.

AMARILLO, TEX.—The Amarillo Water, Light & Power Company will soon add a 150-kw, 2,200-volt generator and a 225-hp engine to its plant. The machinery has not yet been purchased. H. B. Jones is superintendent.

ABILENE, TEX.—The Abilene Light & Water Company has purchased the plants of the Lytle Water Company and the Abilene Light & Power Company. The company will make some extensions and improvements. W. G. Swenson is president.

HUNTINGTON, UTAH.—The Electric Light & Milling Company will receive bids until June 1 for constructing an electric light plant. Wm. Howard is president and general manager.

SANFORD, VA.—It is reported that the town is considering the question of buying the local electric lighting plant.

WILLIAMSBURG, VA.—The citizens voted April 17 to issue $30,000 bonds for water works and an electric light plant. E. M. Lee is clerk of council.

NORFOLK, VA.—The Penn Bridge Company, of Beaver Falls, Pa., has secured the contract for installing a complete water and electrical system in the new marine barracks, at the Navy Yard, for about $11,500.

MORRISVILLE, VT.—The citizens of this village have voted to have the commissioners proceed with the work of establishing a municipal power station. This includes the construction of a large dam across the Lamoille River at Cady's Falls and an expenditure of $75,000 or more. The lake thus created will cover 106 acres, from which a large amount of power can be developed as soon as the power plant is completed. The dam is to be of concrete, 35 feet thick at the base and six feet at the crest, with gates and spillway and a steel penstock 1,106 feet long. A bid of $44,500 for the construction work has already been submitted, but the other necessary work will make the expense $75,000. The commission that will have charge of the work is composed of C. A. Morse, C. A. Gile, C. H. A. Stafford, G. M. Powers and C. H. Clocum.

PORT ANGELES, WASH.—The city is undertaking to change its electric system from steam to water power in connection with a municipal gravity water system. John Hallahan is manager.

RITZVILLE, WASH.—The Ritzville Electric Company is now installing a new McEwen tandem compound engine and a 100-kw Stanley generator. Also a 5-ton ice plant made by the United Iron Works, Oakland, Cal., to be in operation May 1st. H. Warner is manager.

SPOKANE, WASH.—The Spokane & Pend d'Oreille Rapid Transit Company has definitely located most of its line between this city and Lake Pend d'Oreille, a distance of 44 miles. It has acquired 1,600 acres of land on the southwestern shore of the lake and proposes building a town at that point.

SPOKANE, WASH.—The electric power plants of Newport and Bonners Ferry are to be united under the name of the Northern Electric Light Company, and the business for the two concerns will hereafter be conducted under one management. Articles of incorporation for the Northern Company have been filed by A. M. Winston and M. A. Folsom as incorporators. The capital stock is given at $35,000.

SPOKANE, WASH.—The plan of the merger of the Cœur d'Alene & Spokane Railway Company, Spokane Traction Company and the Spokane & Inland Railway Company as the Inland Empire Railway Company, of Spokane, has been approved by the constituent companies, provides for the authorization of a capital stock of $20,000,000. It is planned to issue at the present time about $6,000,000, for the purpose of taking over the capital stock of the Cœur d'Alene & Spokane Railway Company, Spokane Traction Company and Spokane & Inland Railway Company, and the balance will be used for the establishment of a hydro-electric power plant on the Spokane River near Spokane, and the building of an electric railway to connect the same with Spokane. The Spokane & Inland Railway Company will have a total mileage of 115 miles. The company now has the road well under construction.

MILTON, WIS.—A stock company is being organized to build a lighting plant for Milton and Milton Junction.

HUDSON, WIS.—Sealed proposals will be received at the office of the city clerk until May 7th, to do the pumping and to operate the street lighting system in and for the city of Hudson. A. Keras is city clerk.

PESHTIGO, WIS.—John Burke, superintendent of the Peshtigo Lumber Company writes that the company will add two new American water turbines to the present equipment and will make improvements in general amounting to about $16,000. The work is to be done in June.

MILWAUKEE, WIS.—The West Shore Telephone & Telegraph Company, for which the City Council has just voted a franchise, expects to begin at once the construction of a $3,000,000 system in Milwaukee, which also will connect with independent lines throughout the State and elsewhere. The company expects to build a central exchange and four other exchanges in outlying parts of the city.

LARAMIE, WYO.—The Laramie Electric, Gas, Light & Fuel Company, which recently sold its plant here to W. E. Sterne, of Denver, and others, has called a meeting to dissolve partnership and retire from business. On account of the vexatious troubles experienced during the past year with the lighting franchise of the city the municipal ownership of the plant is being discussed, the city reserving the right to buy the plant from the new company. This, it is believed, will solve the problems confronting the city and afford light at a less cost than at the present time.

SALTILLO, MEX.—Alfred Lilliendahl has secured a franchise for an electric light plant.

AMHERSTBURG, ONT.—F. W. Falls, secretary and treasurer of the Amherstburg Electric Light, Heat & Power Company, writes that the company will install a meter system during the next few months.

BRAMPTON, ONT.—The Brampton Electric Light & Power Company has installed three new turbine water wheels, built by Barber & Sons, of Medford, Ont., 24, 42 and 60-inch respectively, and will also add a new 250-kw, 60-cycle, three-phase generator, with a speed of 500 r.p.m. to its plant.

OWEN SOUND, ONT.—The city is considering the question of adding a 500-hp steam or producer gas equipment to the city electric light and power plant. The electric power will be three-phase, 60-cycle, 2,200-volt primary, secondary, 104, for lighting. Joseph McLinden is superintendent.

Company Elections.

BALTIMORE, MD.—At the annual meeting of the stockholders of the Consolidated Gas, Electric Light & Power Company, the board was reelected as follows: Messrs. S. Davies Warfield, John B. Dennis, Alexander Brown, Alten S. Miller, Anthony N. Brady, William A. Marburg, Samuel R. Bertron, T. J. Hayward, Thomas F. Ryan, Charles Adler, Charles T. Crane and F. S. Landstreet.

LINCOLN, NEB.—At a recent meeting, the Nuckolls County Telephone Company elected directors for the ensuing year as follows: J. C. Chamberlain, B. F. Corman, J. C. Day, J. R. Parsons, J. A. Wehrman, W. A. Wehrman, W. A. Voigt and S. A. Lapp.

UTICA, N. Y.—At a meeting of the Utica Gas & Electric Company, the following officers were elected: President, Anthony N. Brady; vice-president, William E. Lewis; treasurer, George H. Stack; secretary, M. J. Brayton; executive committee, John F. Maynard, William E. Lewis, Charles S. Symonds, Charles B. Rogers, Samuel A. Beardsley, Anthony N. Brady (members ex-officio). General manager of the electrical department, C. A. Greenidge; general manager of the gas department, William J. Cahill.

SPRINGFIELD, OHIO.—At a recent meeting of the Peoples' Light, Heat & Power Company, the following officers were elected: John L. Zimmerman, president; L. M. Ferguson, vice-president; J. K. Henry, secretary, and W. W. Keifer, treasurer.

New Industrial Companies.

THE BOSSMASSLER-BONINE ELECTRIC COMPANY, Philadelphia, Pa., has been incorporated with a capital stock of $60,000.

THE DIAMOND GAS & ELECTRIC FIXTURE COMPANY, a new firm just starting in business, will make a specialty of repairing and refinishing electric and gas fixtures at Meriden, Conn.

THE MULTIPHONE COMPANY, New York, N. Y., has filed articles of incorporation with a capital stock of $1,000. The directors are Isaac Thorman, F. G. Wenzel and E. J. Campbell, of New York.

THE VADEM INTERNATIONAL ELECTRO-CHEMICAL COMPANY has been incorporated at New York, N. Y., with a capital stock of $500,000, to develop water power. The directors are E. A. Ashcroft, Murray Hill Hotel; R. L. Redfield, R. P. Lyden, of New York.

THE MARLBORO EQUIPMENT COMPANY, of Marlboro, Mass., with a capital of $3,000, has been incorporated for the purpose of importing and exporting electrical goods. Julius P. Watson is president; Herbert Smith, treasurer, and Eugene W. Godfrey comprise the board of directors.

THE McCREA MOTOR TRUCK COMPANY, of Cleveland, has been formed with $50,000 capital stock by George G. Whitcomb, George H. Kelley, C. C. Easty, L. J. Malin and M. G. MacLeen. The company will manufacture heavy electric trucks and drays. Offices have been opened in the Williamson Building, Cleveland.

THE WATSON ELECTRICAL SUPPLY COMPANY, Ltd., was recently chartered in Shrevport, La. The following officers are named: Ivie M. Watson, president; W. C. Evans, vice-president; W. W. Jones, secretary and treasurer. The company is capitalized at $5,000. W. C. Evans and W. W. Jones, vice-president and secretary-treasurer, are identified with the Shreveport Gas, Electric Light & Power Co.

THE HURLEY MACHINE COMPANY, Chicago, Ill., has incorporated with a capital stock of $150,000 to manufacture the Little Giant floor scraper, the Little Giant electric sandpapering machine and the Little Giant electric floor polisher and surfacer. The plant of the company will be located at 153 to 159 South Jefferson Street, Chicago, and offices have been opened in New York at 1,010 Flatiron Building. The incorporators of the company are Edward N. Hurley, John Maynard Harlan and S. E. Sheehan.

STANDARD ELECTRICAL SUPPLY COMPANY has been formed at Norfolk, Va., under the laws of the State for the purpose of carrying on the electrical supply business in all its branches. The officers of the company are practical electricians, and the companies they are associated with are large consumers of electrical apparatus. The company will carry an up-to-date stock. It has become a member of the National Jobbers' Association, and as jobbers would greatly appreciate receipt of catalogues, price lists, circulars and other trade literature. The company has an establishment also at Charlotte, N. C. The officers are: President, W. N. McAnge, of the Nansemond Telephone Company; vice-president and general manager, Jonathan Woodhouse, P. Anne & Virginia Beach Telephone Company; secretary and treasurer, C. Fred Bonney, Southern States Telephone Company, who are directors with E. C. Hathaway, vice-president and general manager, and H. R. Palmer, general superintendent Norfolk Railway & Light Company, and R. L. Dibrell.

New Incorporations.

LOS ANGELES, CAL.—The Twentieth Century Light Company has been incorporated with a capital stock of $75,000. The incorporators are C. S. Hollis and others.

FORT BIDWELL, CAL.—The Madoc Power Company has been incorporated by Colorado and California men to develop water power on Bidwell and Lake City Creeks for electric light and power purposes.

LOS ANGELES, CAL.—The South Nevada Power & Light Company has been incorporated with a capital stock of $150,000 by U. S. G. Todd, G. D. Gipp, J. D. McNab, T. B. Wickinson and B. F. Rocking, all of Los Angeles.

ARGENTINE, COL.—The Argentine Electric Light & Power Company has been incorporated with a capital of $100,000, by W. B. Le Wall, J. H. Meyers and others.

ADAMS, ILL.—The West Union Telephone Company has been incorporated with a capital stock of $9,000. The incorporators are P. J. Dege and others.

LENZBERG, ILL.—The Risdon Telephone Company has been incorporated with a capital of $500. The incorporators are Henry Kirchoefer and others.

CHICAGO, ILL.—The Chicago Flasher Electric Company has been incorporated with a capital of $10,000. The incorporators are Thos. R. Wood and others.

SPRINGFIELD, ILL.—People's Mutual Telephone Company, with a capital of $10,000, has been incorporated by J. W. Johnson, William Arnsmeier and Fred Albersett.

LITCHFIELD, ILL.—The Secretary of State granted incorporation papers to the St. Louis, Litchfield and Eastern Electric Railroad Company. The directors are J. H. Belt, president, and others. The company is to build an electric interurban line from Alton to Litchfield.

ANDREWS, IND.—The Andrews Electric Railway & Power Company has filed articles of incorporation, with a capital stock of $30,000. H. B. Thornton is president, T. D. Devere is vice-president and W. E. Nichols is secretary.

VINCENNES, IND.—The Vincennes Traction & Light Company has been incorporated with a capital of $200,000 for the purpose of building new lines and supplying electricity and steam for cities in Knox, Gibson, Daviess and Sullivan Counties. Benjamin G. Hudnut, of Terre Haute, is one of the incorporators.

INDIANAPOLIS, IND.—The Goshen, South Bend & Chicago Railroad Company has filed articles of incorporation with the Secretary of State. The capital stock is $150,000. The directors are F. C. Raff, D. D. Bates and John W. Tell, of South Bend; Anthony Deahl, of Goshen, and George S. Lay, of Lafayette.

SOUTH PORTLAND, ME.—The Cape Shore Railway has been incorporated with a capital of $32,000 by Jabez True, Charles Dalton and Edward C. Campbell, of Portland, to construct a street railway in South Portland and Cape Elizabeth.

ST. LOUIS, MO.—The Kobusch Automobile Company, established about sixteen months ago by George J. Kobusch, president of the St. Louis Car Company, has filed articles of incorporation, with a capital stock of $1,000,000. The other stockholders are: Harry F. Vogel, vice-president of the St. Louis Car Company, George A. H. Mills, general manager, and W. S. Miller, manager of the automobile plant.

WADDINGTON, N. Y.—The New York & Ontario Power Company has been incorporated with a capital stock of $2,000,000 to manufacture electricity for light, heat and power purposes and to supply Plattsburg, Ogdensburg, Watertown, Rome, Utica, Syracuse, Oswego and villages in the counties of Franklin, St. Lawrence, Jefferson and Oneida. The directors are David J. Crichton, Jr., John W. Liston and William F. Burt, Ogdensburg.

CINCINNATI, OHIO.—Incorporation papers for the Indianapolis, Columbus & Eastern Traction Company have been asked for. It is reported that this is a project of the Schoepf syndicate and that it will take over all the lines between Indianapolis and Zanesville. It is stated that the Schoepf interests will build a line from Richmond to Dayton parallel to the Dayton & Western Traction Company's line, as the syndicate has been unable to acquire this property. A new road will be built parallel to the National Park. The combination of these roads would make a system over 250 miles and the largest system in the country operating under one management.

BOLTONVILLE, VT.—The Boltonville Electric Company has filed articles of incorporation with a capital stock of $25,000. The company has an option on some of the best water power in the State. It is expected that it will build a large dam and power station to furnish light and power to all the villages in the Wells River valley. The incorporators are M. F. Sargent, Robert Farquarson, James Craigie, C. H. Taplin and H. W. Goodine, all of South Ryegate.

Legal.

CORPORATION CERTIFICATE.—The New York State Commission of Gas and Electricity has received an important opinion from the Attorney General holding that upon application of a corporation for a certificate of authority to transact business the commission need not permit the legality of the consent granted by the municipality to the corporation to be attacked.

NEW YORK CENTRAL POWER—Justice Clinch of the New York Supreme Court has denied the application of the Mount Morris Bank to restrain the New York Central and the New York and Harlem River Railroads from constructing pipes, conduits and wires for the change of motive power from steam to electricity on the viaduct in front of the premises of the bank at 125th Street and Park Avenue. The judge said that it would not be a proper exercise of the equitable power of the court to restrain such an improvement.

PLACING WIRES UNDERGROUND.—The Arlington Telephone Company has brought suit against the Indianapolis & Cincinnati Traction Company to determine which company shall bear the expense of placing wires underground. The telephone company alleges that the traction company placed its high voltage wire beneath and close to the company's wire instead of putting them above or underground; that in case of storm the telephone wires are likely to be blown down and across the high voltage wire of the trolley line and thereby endanger the lives of patrons. The suit is to recover the cost of putting the telephone lines underground at the crossing.

NEW YORK TELEPHONE FRANCHISES.—According to an opinion given by Corporation Counsel Delaney, the Great Eastern Telephone Company will be unable to establish a telephone system in New York City unless it can obtain a new franchise from the Board of Estimate and Apportionment. It was to have done business on the strength of a franchise claimed to have been granted in 1883 to the Electric Lines Company, which it controls. Mr. Delaney's opinion says that the Electric Lines Company never had a franchise, but that it did have a license, which has since been forfeited by disuse. The Great Eastern Company will press the matter, and mandamus the city officials to grant the necessary permit for opening the streets.

Obituary.

MR. G. W. STOCKLY.—We regret deeply to note the death of one of the industrial electric lighting pioneers in this country, Mr. George W. Stockly, who passed away at Atlantic City, on April 20. He was born in Cleveland, Ohio, December 20, 1843. He was a son of John Galt Stockly, a descendant of John Stockly, who came from England and settled in Virginia in 1609 at the first occupation by John Smith. Mr. Stockly studied law for some time after leaving the public schools, and later went into the transportation business. He was a teller of the Commercial Bank of Cleveland for seven years. In 1873 he became manager of the Telegraph Supply and Manufacturing Company, of which he later became president. Mr. Stockly was, it is said, the first man to introduce the telephone into Ohio. He obtained control of the rights for that part of the country, and was the first to establish and operate a telephone exchange there. But he was best known from his prominent and active connection with Mr. Charles F. Brush in the creation of the Brush Electric Company of Cleveland, which manufactured the famous Brush arc lighting system and founded over a hundred local arc lighting companies in this country besides assisting to found allied companies in England and other parts of the world. From 1878 to 1884 a great piece of pioneer work was thus done, laying the bases of the modern electric light industry; and when consolidation was effected with the Thomson-Houston Company, by purchase of the Brush business, Mr. Stockly was able to retire from the field with a large fortune. He engaged in other enterprises, notably one for developing the pneumatic field gun; but his interest in life virtually was crushed out of him when his son, Lieut. Paul Stockly, a young engineer of great ability and promise, disappeared in the Philippines while out on the firing line with one of the guns. A daughter of Mr. Stockly married Owen Johnson, a rising litterateur and novelist and son of R. U. Johnson, editor of the *Century* Magazine. Mr. Stockly was a member of several clubs in Cleveland and of the Lotos and Lawyers' Clubs of New York.

Personal.

MR. L. F. BOWER.

MR. L. F. BOWER, formerly manager of the Electrical Works of the Allis-Chalmers Company in Cincinnati, who was recently promoted to the position of comptroller of the company, has already assumed the duties of his office, with headquarters at the general offices, Milwaukee. He was born and spent the early years of his life in Berwick, Pa. He attended Wesleyan University, Middletown, Conn., from which he graduated in 1879. For five years following graduation, he held a position in the treasurer's office of the Jackson & Woodin Mfg. Co., Berwick, Pa., where he became intimately associated with the persons now in control of the American Car & Foundry Company. Mr. Bower then spent three years in Carlisle, Pa., as principal of the preparatory department of Dickinson College. For one year thereafter he was managing partner of Bower & Mallory, chain manufacturers in Carlisle, Pa. Having sold out his interests to the Standard Chain Company, he was, for two years, superintendent of the car department of Allison Mfg. Company, in Philadelphia, which concern he left on the death of Mr. Allison. For six years Mr. Bower was manager and treasurer of the Carlisle Mfg. Company in charge of all departments. They manufactured freight cars, frogs and switches, and vertical steam engines. From 1896 to 1901 Mr. Bower was secretary and treasurer of the Dickson Mfg. Company, of Scranton, Pa., manufacturers of locomotives and all kinds of heavy machinery. When the machinery department of this concern was absorbed by the Allis-Chalmers Company in 1901, Mr. Bower was retained as manager of the Scranton plant until 1904. On April 1, that year, he went to Cincinnati as secretary and treasurer of the Allis-Chalmers Company's electrical department, and in 1905 he was appointed manager. While at Scranton, Mr. Bower studied law and was admitted to the bar of Lackawanna County.

MR. JOSEPH H. THOMPSON, JR., has removed his offices from 11 Broadway, New York City, to 17 Battery Place.

MR. R. BORLASE MATTHEWS, formerly with the General Electric Company at Schenectady, has been appointed electrical engineer of the Edison Light & Power Company, Amsterdam, N. Y.

MR. TRUMAN HIBBARD, chief designer of the Electrical Machinery Company of Minneapolis, has been giving a course of lectures at the University of Minnesota on factory methods in electrical design.

MR. CHARLES A. BROWN, of Chicago, has moved his offices in the Monadnock Building to 1550 and will continue the practice of patent law in association with Lynn A. Williams, Charles J. Schmidt and Harvey L. Hanson.

MR. F. L. MARTIN, who has had charge of the advertising of the Stromberg-Carlson Telephone Manufacturing Company for the past few

years, has resigned his position to assume one with White's Class Advertising Agency of Chicago.

MR. A. C. WALTHER, electrical and mechanical engineer, who has had a great deal of experience in the design of large power stations and suburban street railway systems, has accepted a position with Ford, Bacon & Davis, of New York City.

MR. EDGAR S. NETHERCUT, chief engineer of the Buda Foundry & Manufacturing Company, of Chicago, was elected assessor of Evanston, Ill., at the last election. Mr. Nethercut is one of the first two prohibitionists to be elected to office in Evanston.

MR. HARRY H. HORNSBY, conduit sales manager of the Sprague Electric Company, has recently returned to New York from a very successful trip through the West and South. He reports business as very active and the outlook promising in those sections.

MR. T. M. MESTON, secretary of the Emerson Electric Manufacturing Company, of St. Louis, has been spending the new in New York on important business, and in visiting local headquarters. He reports the western outlook as generally bright and promising.

MR. A. E. AEBY, who has been connected with the office of the Pennsylvania Steel Company and the Maryland Steel Company for the past 18 years, has resigned as sales agent, to accept the position of general manager of the Carbon Steel Company. Mr. John C. Jay, Jr., his assistant, has been appointed New York sales agent to take effect May 1, 1906.

MR. FRANKLIN M. NICHOLL has been appointed Eastern manager of the Streeter Journal Bearing Company. Mr. Nicholl, who will make his headquarters in the new Reed & Barton building in New York City, was recently connected with the F. B. Tait Manufacturing Company, of Decatur, Ill., and was previously with the Rochester Railway Company of Rochester, N. Y.

MR. H. M. WARREN, electrical engineer of the Delaware, Lackawanna & Western Railroad, will deliver an address on May 8, before the New York Alumni Association of the Worcester Polytechnic Institute, on the electrical work on the railroad and on the use of electricity in the company's extensive coal mines. The lecture will be at the Hotel Albert, preceded by a dinner.

MR. J. L. ADAMS, manager of the Hartford, Manchester & Rockville Traction Company, of South Manchester, Conn., has been appointed general manager of the Indiana, Columbus & Eastern Railway Company with headquarters at Columbus. This is the company formed by the Schoepf syndicate to take over all the lines between Dayton and Zanesville, heretofore known as the Tucker-Anthony lines and the Appleyard lines.

FRANK A. PARKER, for thirty-one years connected with the Quincy Gas & Electric Company, has tendered his resignation with the request that the same be accepted as early as possible so that he may assume the local management of the new Quincy Home Telephone Company, which plant is speedily nearing completion. A more competent man for the new telephone company than Mr. Parker would be hard to find for the new enterprise.

MR. A. B. CORYELL, formerly manager of the Huntsville Railway, Light & Power Company, of Huntsville, Ala., has been appointed general manager of the Chickasha Heat & Power Company, Chickasha, I. T. Mr. Coryell is an expert electrical and mechanical engineer, having made it a study all his life, and has had the management of several first-class properties, installing many electric plants and railway systems.

MR. N. J. NEALL, who has for the last few years represented the Westinghouse Electric & Manufacturing Company in the design, development and application of lightning protective apparatus, has recently resigned to open an office for himself in Boston, Mass. Special attention will be given to protective apparatus in all phases of its development and application; also to high-tension installations, rehabilitation of existing electrical plants and to general engineering problems, particularly those of an alternating-current character.

MR. E. G. ACHESON has been invited to deliver an address before the Department of Engineering, Sibley College, Cornell University, on May 3, His subject will be "Discovery and Invention." This address will be in a revised form, virtually the same as that given in March before the Massachusetts Institute of Technology. It deals with invention without discovery; discovery without invention; and discovery with invention. References are made to Mr. Acheson's own admirable work in the electrochemical field, with deductions from the lessons that it teaches. The American Electrochemical Society will be in session in Ithaca at that time.

MR. G. L. H. ARNOLD, formerly principal assistant to Mr. F. A. Waldron, consulting engineer, has been appointed engineer of construction of the National Cash Register Company of Dayton, O., and will be in direct charge of the design and construction of the extensive additions and alterations of plant now under way. Mr. Arnold is a graduate of Yale, and was for several years associated with the late Mr. Miers Coryell in the exploitation of the Belleville water-tube boiler. Subsequently he became chief draftsman and later mechanical engineer of the Atlas Portland Cement Company. He has had an extensive experience in the design and construction of industrial plants and in reinforced concrete construction and is a member of the American Society of Mechanical Engineers and an associate member of the American Society of Naval Engineers.

Trade Publications.

LAMP SOCKETS AND SHADES.—Flyer No. 2176 of the General Electric Company, Schenectady, N. Y., is devoted to universal lamp sockets and shades and portable desk lamps. By the use of these universal fittings the incandescent lamp is made to give a powerful but well-diffused illumination in the desired direction, while the lamp itself is concealed.

DE LA VERGNE.—We have just received from the De La Vergne Machine Company of New York, an artistic little four-page mailing card, which we understand is for free distribution. On the first three pages are illustrations of some of the many different types of refrigerating machines, both vertical and horizontal, which this company builds. The fourth page gives a short description of the company's chief products in addition to refrigerating machines, namely, the "Hornsby-Akroyd" oil engine and the Koerting gas engine.

News of the Trade.

CHARLES WIRT & CO., of Philadelphia, have moved to a new address at Stenton Avenue, above Wayne Junction, corner of Rockland.

CLARK INSULATION COMPANY.—The Clark Insulation Company, H. B. Burley, treasurer, has changed its name to Boston Insulated Wire & Cable Company, which is now in force.

THE WARNER & SWASEY COMPANY, of Cleveland, prominent manufacturers of machine tools, is making a large addition to its plant and is placing contracts for the machinery for a large power station.

THE SPRAGUE ELECTRIC COMPANY reports a constantly growing demand for its flexible conduits and armored cables, manufactured under the Greenfield patents. Last month was a banner month in total sales.

DE FOREST LABORATORY.—The American De Forest Wireless Telegraph Company is moving its laboratory on or about May 1 to the building corner of Hudson and Sussex Streets, Jersey City, N. J., where it will increase its available space four times.

THE STAR ELECTRIC COMPANY, of Warren, Ohio, which is associated with the Standard Electric Company, of Niles, manufacturer of electric lamps and fans, has opened a factory in the old skating rink at Warren, where it will manufacture storage batteries.

THE REMY ELECTRIC COMPANY, of Anderson, Ind., contemplates moving its works to Richmond, Ind., and will erect a factory building at a cost of $20,000. The company manufactures electric sparkers for automobiles, gasoline launches and all kinds of gas and vapor engines.

THE BLAKESLEE AUTOMOBILE COMPANY, of Cleveland, Ohio, has increased its capital stock from $25,000 to $100,000. The company manufactures electric automobiles, and it is erecting a large factory on Wilson Avenue, Cleveland. J. R. Blakeslee is at the head of the company.

THE CLING-SURFACE COMPANY, of Buffalo, N. Y., manufacturer of Cling-Surface "for belts and ropes," has just moved into a fine new plant which it has erected in Buffalo at 1032-1048 Niagara Street. This new plant is of the most modern fire-proof construction—brick, concrete, hollow tile and wire glass, for wall, floor and ceiling. The increased domestic and foreign business of the firm has necessitated the change and the present new plant trebles its capacity.

THE G. M. DAVIS REGULATOR COMPANY has established a branch office at 117 Market Street, St. Louis, Mo., where it will carry a complete stock of specialties which it manufactures for the benefit of its increasing trade in the Southwest. This company makes the Davis pressure regulator, steam trap, back pressure valve, damper regulator and other power plant specialties. Its factory and main office are at 144 Milwaukee Avenue, Chicago.

JOHN A. ROEBLING'S SONS COMPANY announces the total destruction of its store and warehouse in San Francisco. In order that the coast trade may be promptly supplied, stocks in the companies' warenouses in Los Angeles, Portland and Seattle will be largely increased. Until arrangements can be made for a resumption of business in San Francisco, it is requested that those who have been dealing with the company there divert their orders to one of the other three coast branches.

NEW WAGNER FACTORY.—The Wagner Electric Manufacturing Company, of St. Louis, has completely outgrown its present quarters and has bought a tract of land 15 acres in extent, just outside the city. It has engaged Dodge & Day, of Philadelphia, to make the layout, design buildings and select the necessary equipment. The preliminary layouts have been submitted and the buildings decided upon. Work will be started at once and about one-third of the ground will be covered by buildings before the end of the present year.

THE C. E. HEWITT COMPANY, 17 Park Row, New York City, begs to announce that by an agreement just completed, its entire business interests will be merged in a new corporation to be known as the Stevens-Hewitt Engineering Company, which will continue the business as heretofore and will take over all existing contracts and liabilities of the C. E. Hewitt Company. The rapid growth of the business conducted by the C. E. Hewitt Company has made it necessary, it is said, to enlarge its technical staff and to enlarge its facilities for financing the increasing number of important municipal and other contracts for installation of lighting and power plants that it is engaged in. All of the members of the C. E. Hewitt Company will come into the Stevens-Hewitt Engineering

Company, and the new members, Mr. Edwin A. Stevens, of Hoboken, N. J., and Mr. Irving Cox, of New York, are well known.

THE CENTRAL ELECTRIC COMPANY, Chicago, is bringing to the attention of construction men the Western Union standard steel cross arm pin, for which it is general Western selling agent. This pin has been adopted as a standard by the Western Union and Postal Telegraph Companies, and is made according to their specifications. A highly carbonized steel is used insuring great stiffness and strength, which is very important, especially during storm periods when great damage is often done through the breaking off or pulling out of wooden pins. Another point in favor of this pin is that it only requires a ½-inch hole bored in the cross arm, as against a 1½-inch hole for the wooden pins. It will be readily seen that this strengthens the cross arms. It is suggested that construction men write to the Central Electric Company, 264-270 Fifth Ave., Chicago, for prices and information concerning these pins.

McGRAW BUILDING.—A contract has been placed with Frank B. Gilbreth, New York, for the erection of a building on Thirty-Ninth Street, between Seventh and Eighth Avenues, for the McGraw Publishing Company, publisher of *The Engineering Record, Street Railway Journal,* ELECTRICAL WORLD and other periodicals. The plot is 126.4 feet front and 98.9 feet deep. It is planned to make this structure ten stories high, with the basement and lower floors devoted to printing machinery, the top floor to an engraving establishment and the remaining floors to offices. It is proposed to construct this building entirely of reinforced concrete. It will be the most important concrete structure in New York City, and will have much influence in determining the future of such work, but until the specialists who are preparing the plans and the Building Department of the city which must approve them, have definitely reached a conclusion, no definite plans can be made. The building is designed by Prof. William H. Burr and Messrs. Radcliffe & Kelley. Mr. W. S. Timmis, consulting engineer, will be in charge of the mechanical equipment of the printing offices.

NEW INSULATED WIRE PLANT.—The new plant of the Electric Cable Company was formally opened at Bridgeport, Conn., on the afternoon of Monday, April 16. Refreshments were served by the officers of the company to members of the Bridgeport Board of Trade and to neighboring manufacturers, representatives of the press, and employees of the company. The new building is a one-story brick structure occupying a space 230 by 62 feet on the corner of Crescent and Cenral Avenues. Room is provided for 300 employees and for 30 machines. The plant is equipped with a steel traveling crane which carries the finished product to a platform erected on the north side of the building. Thence the products will be loaded on the cars which will be run from the main line of the New York, New Haven and Hartford Railroad over a private sliding. It is the intention of the Electric Cable Company to erect further buildings on the large plot of ground at the west of the present plant. The Electric Cable Company was incorporated in January of this year with a paid-up capital of $500,000, which in the near future will be increased to $1,000,000. Its products include Voltax, the new insulating compound which is taking the place of rubber, magnet wire, field and armature coils and soldered mesh rail bonds. Large orders have already been received from the Interborough Company of New York, the Brooklyn Rapid Transit Company and other large concerns.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 17, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

817,746. ELECTROSTATIC APPARATUS; Lucien I. Blake, Lawrence, Kan. App. filed Jan. 23, 1905. A rectifier or converter for alternating currents fom an induction coil or a transformer, comprising a closed casing from which the air may be exhausted to any degree, and having a pair of electrodes therein. One of the electrodes is covered with silica or insulating substance, and the other electrode is pointed and may be adjusted toward and from the covered electrode.

817,749. ELECTRICAL APPARATUS FOR DETERMINING THE LOCATION OF METALLIC ORES; Fred H. Brown, Los Angeles, Cal. App. filed Mar. 31, 1902. An apparatus for locating buried ore and minerals, working on the resistance or Wheatstone Bridge principle. A number of metallic stakes are driven into the ground at varying points and the resistance of the ground between the various stakes is measured.

817,761. TELEPHONIC REPEATER; Merritt Gally, Brooklyn, N. Y. App. filed Apr. 14, 1904. In a telephone-repeater for repeating telephonic pulsations from one telephone-line to another telephone-line; a single receiving-diaphragm; and two independent receiving-magnets, both magnets on one side of said diaphragm and to operate said single diaphragm, one of the magnets for connection with one telephone-line, and the other magnet for connection with the other telephone-line.

817,767. ELECTRIC FURNACE; John F. Hammond, Brewster, N. Y. App. filed Apr. 13, 1905. In a furnace, the combination with a muffle whose interior is wound with a heat-generating wire, of a casing for said muffle and whose exterior is wound with a resistance-wire, both of said wires being connected, and means for traveling from one to another of the convolutions of the resistance-coil for varying the resistance.

817,781. MULTIPLE SWITCHBOARD FOR TELEPHONE - EXCHANGES; Milo G. Kellogg, Chicago, Ill. App. filed Nov. 30, 1891. In a telephone-exchange system, a metallic-circuit and a ground-circuit line connected together in a complete circuit for conversation from the ground of the subscriber's ground-circuit line through such line and thence through the metallic-circuit line to ground at the central office, two circuit connections of high retardation, one for each line, through both of which respectively said complete circuit is grounded at the central office and the line-annunciators forming part of said circuit connection, substantially as set forth.

817,807. ELECTRIC MOTOR; Charles H. Roth, Chicago, Ill. App. filed Dec. 27, 1904. A system for avoiding distortion of the magnetic field by armature reactions under different loads and field strengths. The field has a plurality of poles which are energized in combinations or separately so as to give the same field location under the same or different field strengths.

817,827. SYSTEM OF CHARGING STORAGE BATTERIES; Asbury G. Wilson, Wilkinsburg, Pa. App. filed Mar. 14, 1905. The system relates to charging storage batteries from an alternating-current circuit. The patentee employs chemical rectifiers in the circuit of the transformers and charges storage batteries by the uni-directional current produced.

817,843. ELECTRICAL MEASURING INSTRUMENT; John C. Gano, Chicago, Ill. App. filed July 24, 1905. Mechanical construction of an ammeter or volt meter having permanent fields and an armature pivoted between the pole pieces thereof. Each of the pole pieces has a face eccentric to the armature so as to produce a varying turning moment thereon for different current strengths.

817,846. TROLLEY HEAD AND CURRENT COLLECTOR; John E. Greenwood, Utica, N. Y. App. filed Oct. 31, 1904. In place of the usual harp, the patentee provides a centrally swiveled arm upon the pole, which carries two trolley wheels, one at each end. The journals of the trolley wheels are specially made so as to permit easy removal of the wheels.

817,857. ELECTRICAL MEASURING INSTRUMENT; John M. Lea, Chicago, Ill. App. filed July 31, 1905. Relates to a measuring instrument of the same general type as patent No. 817,843 above mentioned. In this case, however, the armature core is fixed and the coil is pivoted to be movable between the armature and the field magnet pole faces.

817,858. AUTOMATICALLY TRIPPING TROLLEY POLE; Thomas H. Mars, Chicago, Ill. App. filed July 12, 1905. The trolley pole has an extensible link connection with a spring which normally holds the wheel against the wire, but the spring is tripped out of operative relation by any sudden upward movement of the trolley pole. The extensible link serves to re-position the parts in normal relation when the pole is drawn downward.

817,860. SIGNAL FOR SWITCHES; Bernard G. Matz and Michael Wozniewski, Chicago, Ill. App. filed July 17, 1905. The switch point has mechanical connections with a rocker arm which moves a switch lever over segments to illuminate different signal lamps.

817,863. WINDING MACHINE; Edwin H. Smythe, Chicago, Ill. App. filed June 24, 1905. Details of a winding machine of that general class in which an annular gear is threaded through the circular core to be wound, and the annular gear is made to carry the spool of wire around the core until the latter is wound.

817,867. SUPERVISORY SIGNAL FOR TELEPHONE - SWITCH BOARDS; Frank R. McBerty, Evanston, Ill. App. filed Jan. 24, 1902. The combination with a source of current, of a local circuit having two parallel branches with a signal device in each branch, means for opening and closing each branch, a resistance in the undivided portion of the circuit and an electromagnetic switch controlling a shunt or short circuit of the resistance, the source of current, signal devices and resistance being proportioned to prevent the actuation of either signal device when both of said parallel branches are closed, one of said signal devices being adapted to be actuated by the increased current when the resistance is shunted by the switch, substantially as described.

817,869. ELECTRICAL MEASURING INSTRUMENT; Joshua Patrick, Chicago, Ill. App. filed Aug. 3, 1905. Details of construction of a measuring apparatus of the general type of patent No. 817,843 above mentioned. Relates particularly to the trunnions and pivot supports of the movable element.

817,892. ELECTRIC CLOCK; Guy H. Andrews, Eastland, Cal. App. filed Aug. 22, 1905. Constructiion of a clock adapted to close an electric circuit at periodic intervals, for example, every minute. The patentee specifies as important features, a pair of tiltably mounted inclined tracks, and a balance wheel having a staff or spindle for altering the position of the tracks.

817,920. METERING OF TELEPHONE SERVICES; Isidor Kitsee, Philadelphia, Pa. App. filed Oct. 29, 1904. In a telephone system wherein the outlying subscriber centers through a circuit in an exchange, means at said exchange to register the value of the conversation at the outlying station, said means embracing at the exchange automatic means to make and break a circuit in accordance with the value to be registered, means to connect this make-and-break means to the circuit of the subscriber and a grounded source of current for said make-and-break means, and which embraces at the subscriber's station a registering device.

817,921. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed June 24, 1904. A composite sectional line conductor comprising a plurality of sections, each section consisting of conductively independent conductors twisted together, one of said conductors being common to neighboring conductors.

817,926. TRANSFORMER; Carl A. Lohr, Wilkinsburg, Pa. App. filed Apr. 27, 1905. A method of winding transformers so as to avoid intimate proximity of parts or windings having wide potential differences. The circuits are divided into alternately disposed sections with links connecting the inner and outer terminals of the sections of the low voltage circuit, said links being disposed alternately inside and outside of the sections of the high-voltage circuit.

817,832. ELECTROPLATING-TANK; Clarence G. Backus and George L. Wallace, New York, N. Y. App. filed July 27, 1905. In a device of the kind described, a tank, arms attached at one end to a side of the same and a rotatable drum supported by the outer ends of said arms, and means for raising said drum out of said tank and lowering it on one side of the tank substantially as described.

817,945. ELECTRIC CONTROLLING DEVICE; Frederick L. Willard, Brooklyn, N. Y. App. filed Oct. 2, 1905. The object of the invention is to provide a controlling device for use in connection with electric power apparatus for illuminating signs. A plurality of circuit closing switches are actuated by electromagnets with compound windings specially connected together and with relation to the lamp circuits.

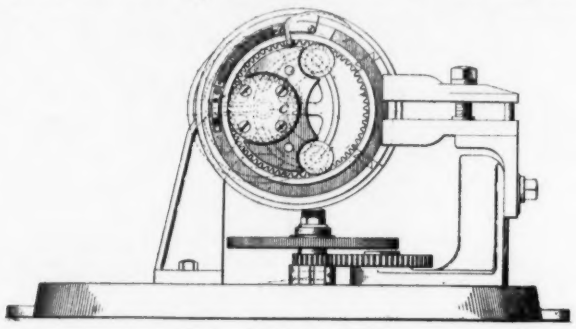
817,976. ULTRA VIOLET LAMP; Thomas B. Kinraide, Jamaica Plain, Mass. App. filed June 12, 1905. An electrode for an ultra-violet lamp

consisting of a plurality of metal plates clamped together in mutual contact at the discharge end thereof and spread apart from each other at the opposite end of said electrode.

817,959. ALARM-FUSE FOR TELEPHONE EXCHANGES; Edward B. Craft, Chicago, Ill. App. filed Feb. 5, 1904. A protectiye device comprising an insulating mounting-strip and terminal plates therefor, a spring secured to one of said terminals, a fuse-wire electrically connected with the other terminal and united with said spring to maintain the same under tension, and a target carried by said spring, said spring when under tension holding said target in an inconspicuous position, but being adapted upon the parting of the fuse to move said target into a position of display.

817,998. MEANS AND METHOD OF TRANSMITTING POWER; William Stanley, Great Barrington, Mass. App. filed Mar. 10, 1905. In a system of distribution, the combination of means for generating low-frequency currents of high potential mains leading therefrom, step-down transformers connected in multiple to said mains, and motors of the commutator type connected to the secondaries of said transformers.

818,027. INDUCTION-MOTOR; Dugald C. Jackson, Chicago, Ill. App. filed Mar. 8, 1900. The method of operating an induction motor, provided with an armature having a progressive winding, a commutator, and auxiliary conductors for short-circuiting conductors of the armature-winding, which consists in establishing a field by a single-phase alternating current, subjecting the progressive armature-winding to the influence of the said single-phase alternating field, inducing currents in the said armature winding and passing the same



817,883.—Winding Machine.

in progression through the coils of the armature-winding, the commutator and brushes, whereby the motor is started, changing the number of poles of the field to which the armature is subjected, and conveying current between the coils of the armature that are subject to unlike poles of the field through said auxiliary conductors for normally operating said motor.

818,035. ELECTRIC SWITCH; Henry E. Leppert, New Britain, Conn. App. filed Apr. 24, 1905. A rotary snap switch including a ball clutch which is released to permit an abrupt movement of the switch element.

818,068. REGISTERING APPARATUS FOR TELEPHONE EXCHANGES; Clarence E. Wright, Cleveland, O. App. filed Jan. 19, 1905. In apparatus of the class described, the combination with a controlling-circuit-closing device, of a source of current, an electrically-actuated counter, another electrically-actuated counter, and means for supplying interrupted current thereto and adapted to be connected with the latter, substantially as set forth.

818,133. COMBINED SYSTEM OF ELECTRIC SIGNALING AND SWITCH SETTING FOR RAILROADS; Bruno O. Wagner, El Paso, Tex. App. filed Oct. 28, 1904. Specific construction of a complete signaling system having electro-magnetically operated switch points and various operating and signal circuits, including means for heating the rails in winter.

818,145. TELEGRAPH SYSTEM; Myron J. Carpenter, La Grange, Ill. App. filed June 2, 1905. In a system of telegraph, the combination of a telegraph-key, a telephone-transmitter, a support common to both adapted and arranged to communicate mechanically vibrations due to the manipulation of the telegraph-key to the telephone-transmitter, a source of electric current, and a circuit including said source of current, the key, and the transmitter in series, whereby said transmitter is responsive to the sound-vibrations and to the current variations produced by the manipulation of said key.

818,169. ELECTRICAL CIRCUIT AND DEVICE; Robert J. Hewett, Westfield, N. J. App. filed June 2, 1905. An over-lap block signal system operated by the successive short circuiting of the rails by the train axles. The invention is designed to effect an economy in the power consumption of the signal circuits.

818,170. ELECTRICAL DEVICE AND CIRCUIT; Robert J. Hewett, Westfield, N. J. App. filed June 2, 1905. Relates to modifications of the above.

818,174. PROCESS OF RECLAIMING WASTE GOLD AND OTHER VALUABLE METALS FROM WATER AND OTHER LIQUIDS; Charles E. Holland, New York, N. Y. App. filed June 5, 1905. The process of reclaiming gold or other precious or valuable metals from water or other liquids, consisting in conducting the stream or body of liquid to an electrolytic apparatus, subjecting it to electrolysis, in the presence of a body capable of forming a coagulum, and collecting the coagulum produced thereby.

818,186. INSULATING CLEAT; Henry D. Murdock, Wilkinsburg, Pa. App. filed July 17, 1905. A two-part cleat, one member of which has a deep groove, and the other member of which has a proturberance engaging said groove, but leaving a space for the reception of the wire or cable to be clamped.

818,203. RAILWAY SIGNAL CONTROLLING CIRCUIT; Herbert B. Taylor, Newark, N. J. App. filed Oct. 1, 1900. Relates to improvements in "open rail circuits," the object of the improvement being to provide a signal controlling circuit with all the functions of any of the standard rail circuits now in use with the additional features peculiar to this circuit, which simplify the operation of the signals and render them more sensitive to control.

818,226. ELECTRIC SWITCH; Lewis R. Brown, South Orange, N. J., and Fred H. Wentworth, New York, N. Y. App. filed May 5, 1905. Details of a switch including a mercury cup and a movable bar moved by an electromagnet arranged to enter said mercury cup and complete a circuit when desired.

818,236. SPACE SIGNALING SYSTEM; Cornelius D. Ehret, Ardmore, Pa. App. filed July 27, 1903. Relates to apparatus for generating electro-radiant energy and impressing it upon the natural media in such manner that a plurality of separate trains or waves of electro-magnetic energy are simultaneously transmitted, such wave trains being dephased or displaced as to time with respect to each other.

818,253. INCANDESCENT LAMP SOCKET; Walter J. Jones, Hackensack, N. J. App. filed Dec. 3, 1900. An automatic cut-out for series incandescent lamps including a pair of spring blades which are separated by a thickness of tissue paper which breaks down in case the potential rises due to a burn-out of the lamp.

818,290. HIGH-TENSION CIRCUIT BREAKER; Robert H. Read, Schenectady, N. Y. App. filed June 25, 1903. A rotary magazine is provided for feeding enclosed fuses into position so that the circuit is broken through the fuse at each actuation instead of at the switch levers.

818,291. ELECTRIC CUT-OUT; Robert H. Read, Schenectady, N. Y. App. filed Sept. 26, 1904. Construction of enclosed fuse in which the pressure generated by the expansion of the air when the fuse burns impels a piston lengthwise so as to separate the contacts of the circuit.

818,299. SNAP SWITCH; Frank W. Sanford, Schenectady, N. Y. App. filed Sept. 30, 1904. Details of a snap switch having an insulating base with a rotary switch blade and stationary contacts, and a push button arranged in line of the axis of the switch blade and operating to put under tension a spring connected to the switch blade so as to release and move the same through a given angle.

818,309. INTERLOCKING SWITCH; Charles W. Stone, Schenectady, N. Y. App. filed Oct. 4, 1904. In combination with an alternating-current generator, two or more sets of main bus-bars, one or more sets of synchronizing bus-bars, main switches and synchronizing switches, and means for interlocking said switches so that when a given synchronizing switch is closed, none but the right main switch can be closed.

818,349. CONTROL SYSTEM; Frank E. Case, Schenectady, N. Y. App. filed Oct. 10, 1904. A system to prevent the careful insulation which is now required for the pilot wire of a train which actuates the circuit-breaking magnets. Provides that the circuit-breaking wire shall be operable to throw the circuit-breakers only when the motor circuits are energized but not when the motor circuits are de-energized.

818,361. ARC WELDING APPARATUS; Arthur C. Eastwood, Cleveland, O. App. filed May 2, 1905. Details of a supporting handle for the electrode which is used in burning over blow holes in castings. Has a perforated supporting handle to dissipate the heat, and an insulating sleeve which is grasped in the hand.

818,363. ART OF SIGNALING THROUGH SPACE; Cornelius D. Ehret, Ardmore, Pa. App. filed Aug. 25, 1905. Relates to methods of receiving wireless messages, and boosting or reinforcing the alternating current produced to more effectually control or actuate a receiver or other translating device.

818,376. ARC EXTINGUISHING CUT-OUT; Edward M. Hewlett, Schenectady, N. Y. App. filed Aug. 8, 1903. The usual copper brush switch blade pressed against anvils or blocks has an auxiliary spring carbon brake between iron pole pieces in an arc expelling chute. The important feature is that the main and the shunt contacts have the same impedance.

818,377. REVERSE CURRENT RELAY; Edward M. Hewlett, Schenectady, N. Y. App. filed Oct. 22, 1904. Comprises a stationary field magnet member, an armature journalled between poles thereof, a cam

818,290.—High Tension Circuit Breaker.

carried by the armature shaft, a reciprocating member adapted to be moved by said cam, and a switch contact carried by said reciprocating member.

818,387. SWITCH-RECEPTACLE; George H. Metheany, Lima, O. App. filed May 25, 1905. A device of the character described, comprising an inverted, cup-shaped casing, said casing provided with an internal screw-threaded surface formed near its lower edge, an annular extension formed upon the inner face of said casing, said screw-threaded surface terminating short of said annular extension, a removable base member positioned within said casing, and contiguous to said annular extension, said base member provided with an upper concaved surface and with a central aperture, said member provided with a conical, depending portion, said depending portion provided with a concaved recess, a standard formed integral upon said base member, ribs extending in opposite directions from said standard and formed integral with said base member, a block formed upon the upper end of said standard, spring-terminals carried by said block, and an annular locking member positioned within said casing for securing said base member in a fixed position, said locking member provided with an outer screw-threaded surface and with inwardly-projecting extensions.